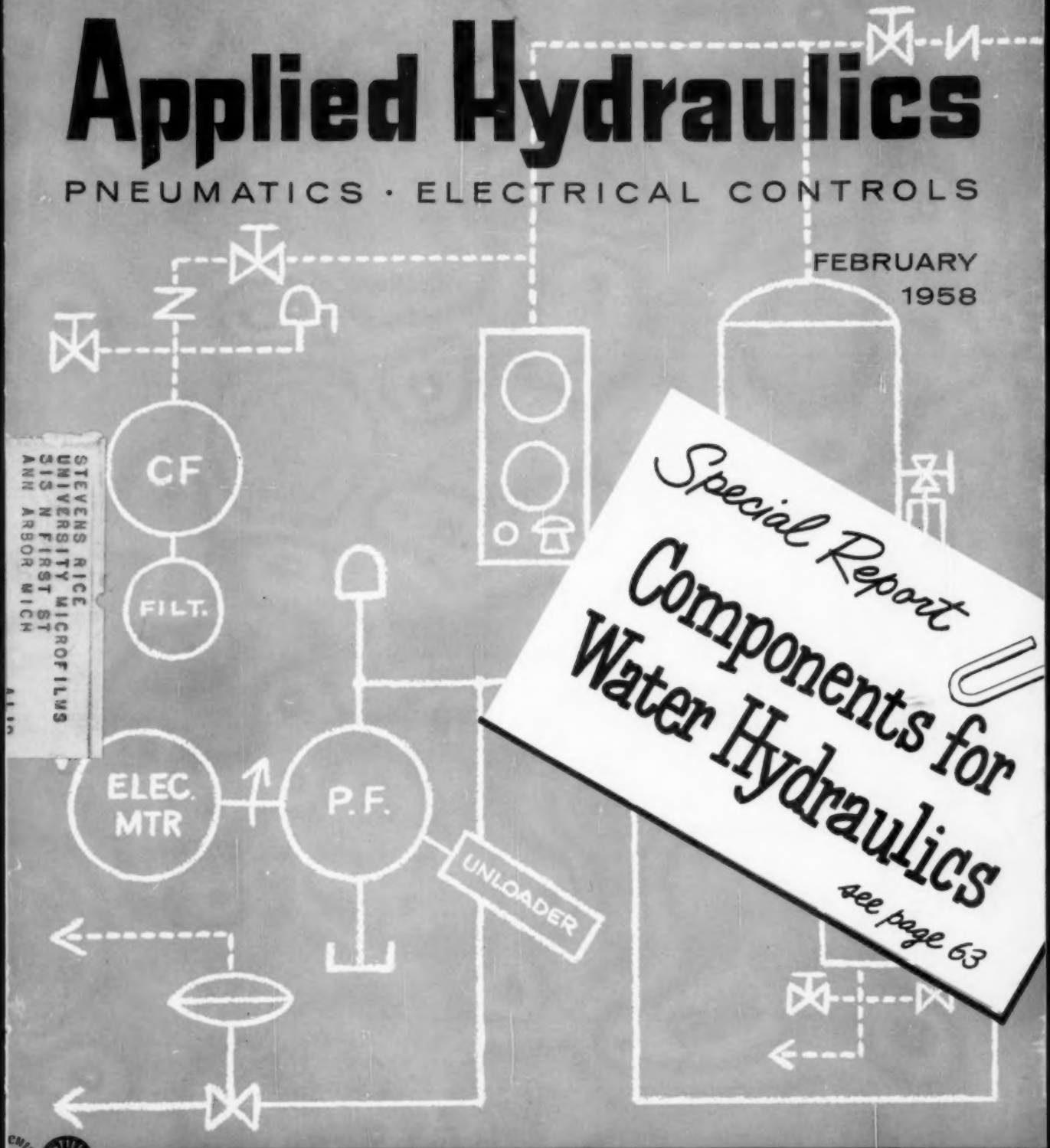
Applied Hydraulics

PNEUMATICS · ELECTRICAL CONTROLS

FEBRUARY
1958



STEVENS RICE
UNIVERSITY MICROFILMS
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Special Report

Components for Water Hydraulics

see page 63

THE MAGAZINE OF FLUID POWER

AN INDUSTRIAL PUBLISHING CORPORATION MAGAZINE

. . . read each month by 26,000 men who apply fluid power products to all types of machines and equipment

shuts off both sides of line... prevents loss of liquid, gas, or pressure.
Available in brass or steel with female pipe thread connections from ⅛" to 1"
FOR PRESSURE OR VACUUM SERVICE

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QUICK-CONNECTIVE TWO-WAY SHUT-OFF COUPLINGS

Both ends of line are positively sealed when you disconnect a Hansen Series HK Two-Way Shut-Off Coupling. To connect, just pull back sleeve and push Plug into Socket. To disconnect, merely pull back sleeve. No tools required. Identical valves in Socket and Plug permit free flow of gas or liquid when Coupling is connected—practically eliminate spilling of liquid or escape of gas when disconnected.

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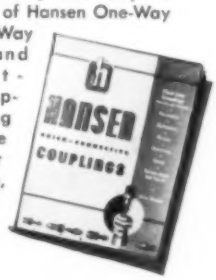
Here's an always ready reference when you want information on couplings in a hurry. Lists complete range of sizes of Hansen One-Way Shut-Off, Two-Way Shut-Off, and Straight-Through Couplings—including Special Service Couplings for Steam, Oxygen, Acetylene, etc.



SINCE 1915 — QUICK-CONNECTIVE FLUID LINE COUPLINGS

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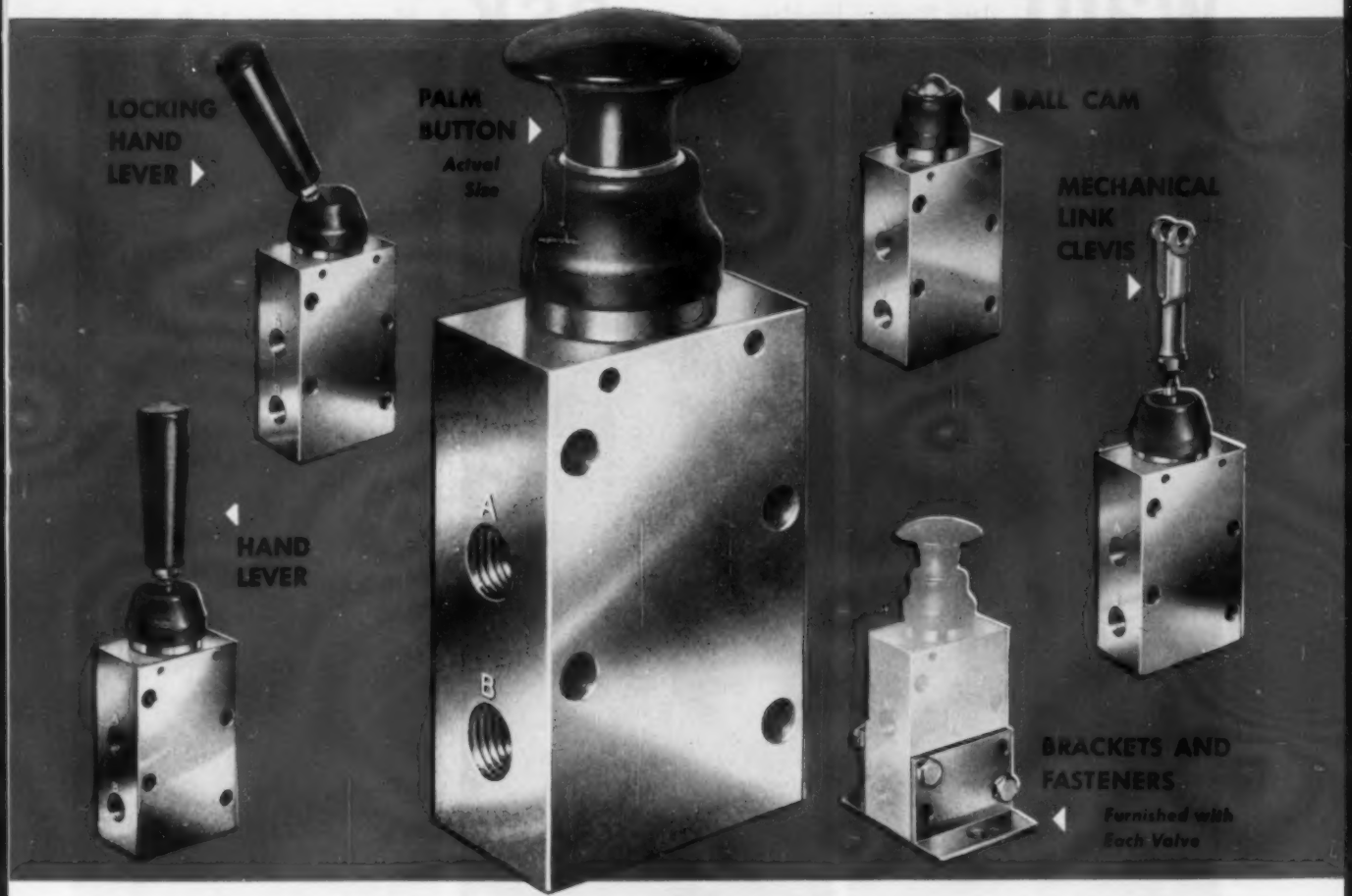
CIRCLE 45 ON PAGE 97

NEW HANNA FLO-PILOT VALVE has dirt-proof seal!



Hanna Flo-Pilot Valves are ¼" two- and three-way Pilot Valves for air operation to 150 psi. They are used for remote control of master valves, directional control of small single acting cylinders and for shut-off. Same valve can be used for two or three-way operation either normally open or normally closed to inlet pressure.

HANNA Flo-Pilot Valves will deliver years of dependable performance at a very low cost because they have built-in money-saving features. Every Hanna Flo-Pilot Valve is equipped with a synthetic boot which seals the valve stem and internal parts from harmful dirt and abrasive, thereby eliminating the most common cause of valve failure.

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Ask your Hanna representative (see the yellow pages or Thomas Register) for complete information or *write direct for Catalog 262.*

Hanna Engineering Works

HYDRAULIC AND PNEUMATIC EQUIPMENT . . . CYLINDERS . . . VALVES

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CIRCLE 44 ON PAGE 97

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Silcone Division explores the frontiers, where new demands are being made for flexibility and durability at extreme temperatures. New Silicone compounds with greater oil resistance, strength and electrical properties are increasingly valuable to today's industry. With seven years of experience in the injection molding and extrusion of silicone, Silicone Division can assure high product uniformity and close-tolerance manufacture.

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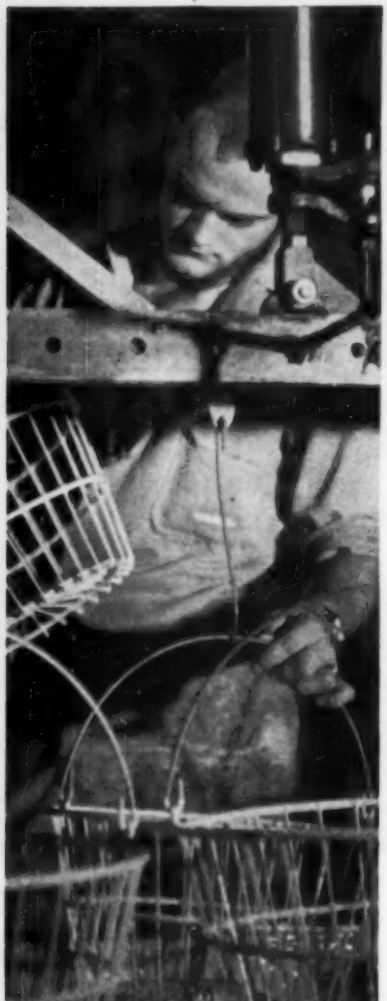

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Plastics and Latex Division specializes in the dipping and forming of a wide variety of articles. Working in the field of polyvinyl chlorides, they have developed new techniques which solve dipping and coating problems more easily, more effectively and more economically. In this field, too, the Minnesota Rubber family of companies gives the finest and most effective service.

Write for the 16-page brochure describing Minnesota Rubber's facilities, also for full information about how Minnesota Rubber can help solve your production problems. Address 3630 Wooddale Ave., Minneapolis 16, Minn. Minnesota Rubber Company—originators of modern rubber injection molding and PROTOTYPES by KOTOKAST.

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Silicone Rubber Division
Plastics and Latex Division
Research and Development Division

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Applied Hydraulics

FEBRUARY 1958 Vol. 11, No. 2 ⊡PA

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THE MAGAZINE OF FLUID POWER

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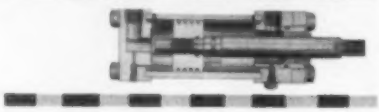
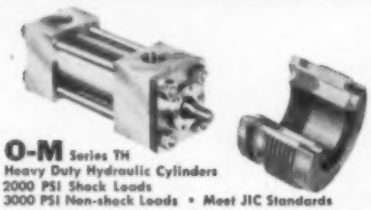
O-M ...a Power-Full Idea in High Pressure Hydraulic Cylinders





O-M Series TH
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2000 PSI Shock Loads
3000 PSI Non-shock Loads • Meet JIC Standards

Tested, tried and proved powerful components in today's fast-moving automation picture, these ruggedly constructed O-M Heavy-duty Hydraulic Cylinders breeze through heavy work loads, withstand shocks and strains, and provide smooth dependable power for a wide range of pressures and operating conditions.

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O-M Series TH High Pressure Hydraulic (oil) Cylinders are available in full range of sizes (1¼" to 8" bores) with standard and heavy duty piston rods.

Mail coupon TODAY for Bulletin 105 showing descriptive drawings of cylinders, mounting accessories and capacity chart.

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☐ Have representative call
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Applied Hydraulics

THE MAGAZINE OF FLUID POWER

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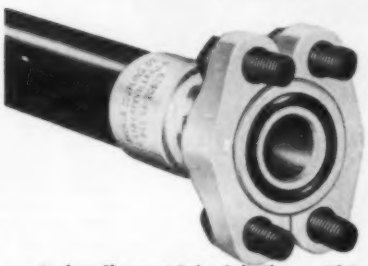
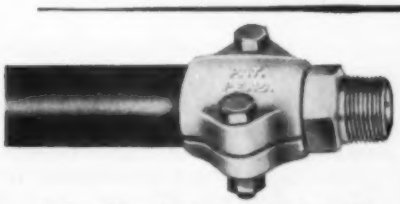
Anchor Adapter Unions, Pipe Fittings and SAE Boss Type Adapters.

Anchor Reusable Couplings for High, Medium and Low Pressure Hose.



Anchor Flanco 4-Bolt, Split-Flange "O"—Ring Couplings with Pressed On Couplings or Clamp Type Reusable Coupling.



Anchor Clamp Type Couplings for high, medium and low pressure.

Anchor L.P.G. Hose Assemblies with Pressed On or Reusable Couplings.

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There is more than a decade of Research and Development behind these

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Here is a complete line, one of the most comprehensive available anywhere today, including couplings, hose assemblies and fittings for any need in the transmission of fluid power.

The Anchor products shown have been developed and re-designed thru the past decade to keep abreast of the rapidly changing field of hydraulics, each style and size offering the most modern features with bonus value in application convenience and service life.

Catalogs are available for each product classification, each with a wealth of diagrams, tables and technical data that are available for your assistance in selecting just the hose assembly or coupling that is best for your particular application.

Andy Anchor says:

A general condensed catalog of the entire Anchor Line is also available. Ask for Catalog 57S.

ANCHOR COUPLING CO. INC.

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CIRCLE 7 ON PAGE 97

You Wouldn't Buy Hydraulic Fluids BLINDFOLDED

only Houghton supplies all types—can give you unbiased recommendations.

Operating pressures and temperatures, pump and equipment design and degree of fire hazard all affect the selection of the right fluid.

Phosphate-Ester Fluids—Houghto-Safe 1000 Series

These fluids are available in three viscosities to meet the needs of systems running as high as 150°F., and where maximum lubricity is needed for heavy bearing loads. Used in deck-edge elevators in Navy carriers.

Water-Glycol Fluids—Houghto-Safe 600 Series

These fluids will adequately meet the requirements of up to 85% of all hydraulic systems. Houghto-Safe 600 series provides maximum fire protection with good lubricity for systems running up to 150°F. Used in catapults in Navy carriers.

Water-Oil Emulsion Fluids—Hydrolubric F.R.

These are lower cost fire-resistant fluids. They are stable, afford good lubricity and provide adequate fire protection where hazards are intermittent or remote.

When you think of fire-resistant hydraulic fluids —call on Houghton. You will get factual, unbiased recommendations of the fluid best suited to your equipment and degree of fire hazard. Factual folders describing these safe fluids are yours for the asking. Write E. F. Houghton & Co., 303 W. Lehigh Ave., Philadelphia 33, Pa.

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Ready to give you on-the-job service . . .

CIRCLE 20 ON PAGE 97

. . . Fluid Power news

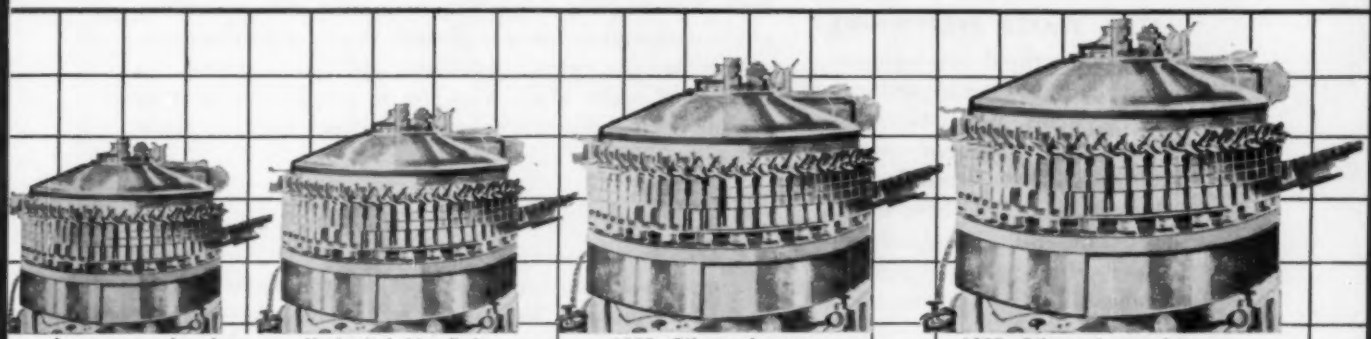
REPORT No. 11,301
HYTAC IMPROVES FILL-CLOSE PRODUCTION

From Oilgear Application-Engineering Files

HOW OILGEAR HYTAC DRIVES IMPROVE FILLER-CLOSER PERFORMANCE—TRIPLE OUTPUT

CUSTOMER: *A Large Food Machinery Manufacturer (Name withheld by request)*

DATA: This manufacturer called upon Oilgear to help solve the problem of producing a filling and closing machine that would exceed the mechanical drive limitations reached when the fill-close rate was increased from 150 to 360 12-oz cans per minute. *Summary of User Requests:* A fill-close rate of at least 425 12-oz cans per minute; accelerate to half speed in 2 seconds—to full speed in 5 seconds without jerky, jack rabbit starts that strain the equipment; reduce spillage and "deadheads"; decelerate to stop in 0.4 seconds; reduce costly losses due to under or overfilling; change speed instantly, easily—with remote control preferred; accurately hold any selected speed regardless of load or electric power variations—viscosity changes; impervious to daily sanitary washdowns; provide trouble-free, low-maintenance, continuous operation.



Average normal mechanical drive—150 12-oz cans per minute.

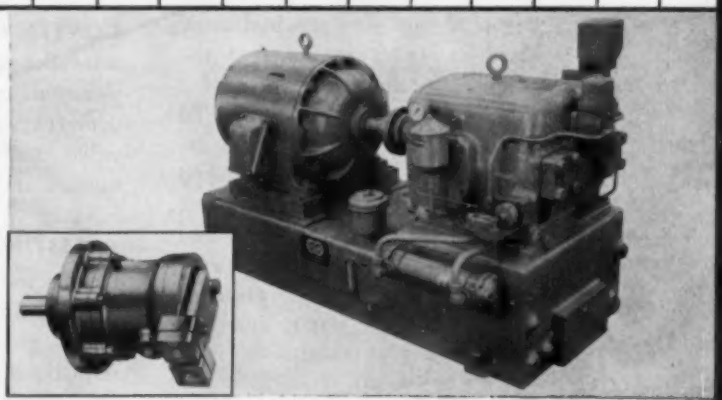
Mechanical drive limit—360 12-oz cans per minute.

1955—Oilgear heavy-duty, Size 20, Any-Speed HYTAC drive—to 600 12-oz cans per minute with improved performance.

1957—Oilgear heavy-duty, Size 35, Any-Speed HYTAC drive—to 1200 12-oz cans per minute with improved performance.

OILGEAR SOLUTION #1 (1955) Oilgear heavy-duty, Size 20, Any-Speed HYTAC (hydraulic tachometer) drives provided the first step in meeting user requests. These drives on a 6-spindle closer and 60-spout filler smoothly accelerated to full speed in 2 seconds—decelerated to stop in 0.2 seconds; a new, high fill-close rate—to 600 12-oz cans per minute without machine redesign; held *any* preselected speed within ± 0.5% regardless of load, electric power variations or viscosity changes—assuring uniform fill; reduced spillage and conveyor jams. Oilgear heavy-duty HYTAC simplified machine design and reduced maintenance by eliminating slip clutches and electric brakes—and by providing hydraulic cushioning; hydro-dynamic braking; automatic, positive protection against starting and running overloads. Remote, space-saving pump and motor location and completely sealed, leak-tight system provided protection to daily, sanitary washdowns. Users liked this improved performance and speed . . . over 50 similar installations have been made. Some users, however, continued to request higher production rates—with all of HYTAC's advantages.

OILGEAR SOLUTION #2 (1957) Due to the proven ability of Oilgear application-engineered, heavy-duty, drive and control systems to help meet user demands, this manufacturer naturally turned to Oilgear for further engineering teamwork in meeting new, greater production requirements. *RESULT*—new, higher production filling-closing machines that TRIPLE original mechanical drive output—to 1200 12-oz cans per minute with all the same desirable features outlined in the previous installations. One important addition has been made . . . new user satisfaction.



This is the newest Oilgear Power-Pak for filler-closers—Oilgear heavy-duty, Size 35 HYTAC drive components. Unit can be remotely mounted and remotely controlled for new performance, new production speed, new accuracy.

Here is but one reason and proof why designers and builders of machinery turn to Oilgear . . . why users recognize and trust the name . . . why more and more this phrase is heard, "For the lowest cost per year—it's Oilgear!"

For practical solutions to YOUR linear or rotary drive and control problems, call the factory-trained Oilgear application-engineer in your vicinity. Or write, stating your specific requirements, directly to

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Application-Engineered Fluid Power Systems

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FLUID POWER LINES

about applied hydraulics

WATER, WATER EVERYWHERE . . . With the rapid developments in oil hydraulics and self-contained systems, we sometimes slight the time-honored central water system. But a stroll through a large plastic or rubber molding plant, with hundreds of presses, brings home the importance of a central pump and accumulator layout.

Design principles of these systems are, of course, the same as other hydraulic systems. But the very fact that the hydraulic fluid is water means that the common pumps and valves for oil service cannot be used. To bring you the special report beginning on page 63, we asked manufacturers of pumps, valves, accumulators, cylinders, and other components for water service to tell why their products are suitable for water, and how they're used.

In setting up a new plant or expanding an older one, the choice between self-contained systems and a central system is an importart one. The central system may have the lower first cost, but flexibility and independence of self-contained units may make them more attractive.

MONEY IN YOUR POCKET . . . Put your know-how to work. You're doing things with hydraulics and pneumatics which will interest other engineers. Here's your chance to gain extra recognition for yourself and your company. To receive a booklet which tells how to prepare an entry in the 6th annual Fluid Power Prize Paper Contest, circle 199 on page 97.

LET IT LEAK . . . It's true that leakage in water systems is not the same monster as in oil systems—no one bothers much about a drop here and there because make-up costs practically nothing. But in larger systems where piping seemingly wanders aimlessly through the plant, leaks can be a problem. In *How to Find Leaks*, pressure gauges help isolate the leak in a particular press line.

CONVERTING A WELDER . . . may sound like a job for a missionary instead of an engineer, but not on the fluid-powered machine described on page 76. The change-over from oil to water required poppet valves. One 4-way valve combines four poppets in one housing. These are opened and closed by a cam-actuated lever.

ARRESTING GEAR . . . could be billy club and handcuffs. In this month's Aircraft Section it's the system for controlling the aircraft hook which picks up a wire strung across a carrier's deck. Orifices solved the speed control requirements for fast lowering, controlled retraction into the airplane.

MORE SERVICE . . . Take a look at the Reader Service Card on page 97. A new feature has been added. You can request single copies of articles. We'll send tear-sheets without charge as long as the supply holds out.

For 50 cents you can get a 16 page reprint of the articles on pages 63 through 78. If you want large quantities write for cost.

PRECISION DYNA-SEAL

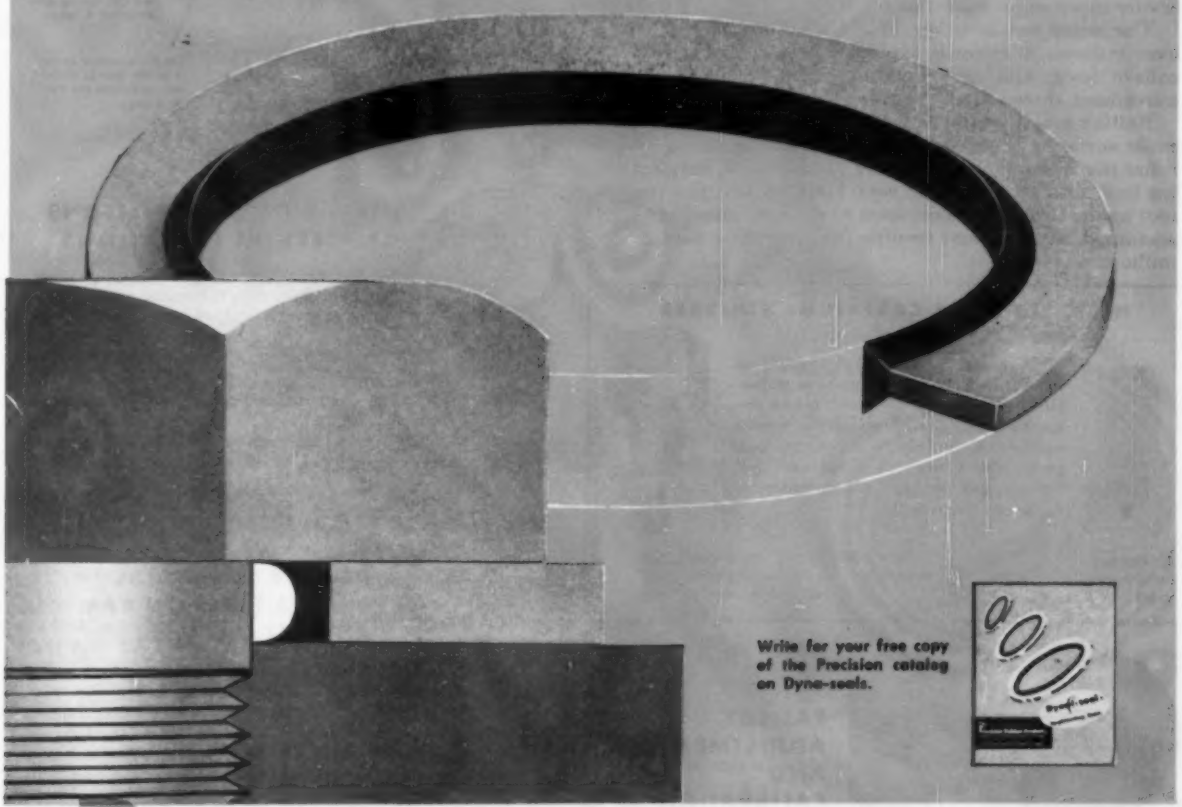
For face to face sealing

Easy-to-handle one piece seal of rubber bonded to a steel washer.

Available in-stock sizes for No. 5 screw to 1-¼" bolt.

No special machining required.
Reduces assembly costs.
Positive sealing up to 10,000 P. S. I.
Vibration proof, lock washer action.
Reduces bolting torque.
Reusable - cuts maintenance.

Let a Precision engineer demonstrate the Dyna-seal cost and labor saving advantages to you.



Write for your free copy of the Precision catalog on Dyna-seals.

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U.S.A.

NOTHING BUT THE BEST IN GAGES FOR WORKING PRESSURES FROM 30" VACUUM TO 10,000 p. s. i.

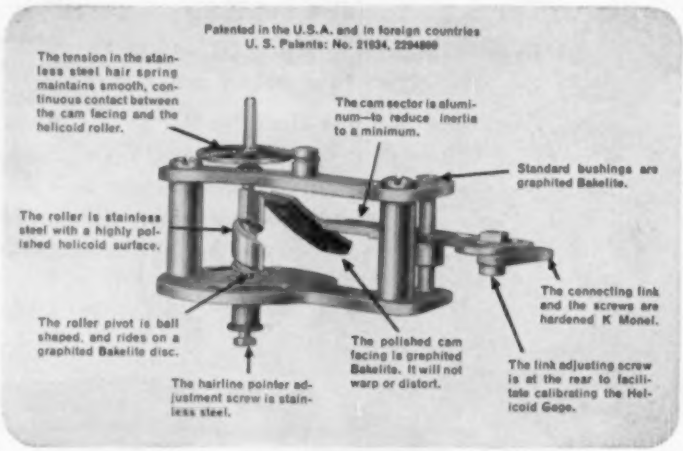
Shock-Proof Cam Actuation (no gears—no teeth) Makes Helicoid Gages Ideal for Hydraulic Services

Designed for pulsating and impact hydraulic service, the Helicoid movement releases at zero in the event of sudden pressure reduction. This eliminates shock on pointer and movement by reducing impact of pointer against pointer stop pin. This protects the gage mechanism where gages may be subject to occasional vacuum.

The superiority of Helicoid Gages is most evident in severe service—wherever a gage is subjected to violent pressure pulsations or certain severe mechanical vibrations.

The *sustained accuracy* of Helicoid Gages over *millions of cycles* is explained by the details of design and construction of the Helicoid movement shown at the right.

Rolling action of the cam facing against the roller surface . . . graphited Bakelite bushings, roller pivot base and cam facing . . . K Monel connecting links and screws . . . all such Helicoid features protect against wear and corrosion and assure sensitivity, sustained accuracy and trouble-free operation through millions of cycles.


Patented in the U.S.A. and in foreign countries
U. S. Patents: No. 21634, 2294869
The tension in the stainless steel hair spring maintains smooth, continuous contact between the cam facing and the helicoid roller.
The cam sector is aluminum—to reduce inertia to a minimum.
Standard bushings are graphited Bakelite.
The roller is stainless steel with a highly polished helicoid surface.
The connecting link and the screws are hardened K Monel.
The roller pivot is ball shaped, and rides on a graphited Bakelite disc.
The polished cam facing is graphited Bakelite. It will not warp or distort.
The link adjusting screw is at the rear to facilitate calibrating the Helicoid Gage.
The hairline pointer adjustment screw is stainless steel.

HELICOID GAGE CARTRIDGE SNUBBER

(Patent pending)

This is a simple, effective throttling device to reduce or eliminate pulsations of the gage pointer. There are no moving parts, no adjustments needed. Available in three types in powdered bronze or stainless steel for air, gas, water, steam, medium or heavy liquids.

Enlarged cutaway view

Threaded cartridge body for assembly in any Helicoid Gage tapped socket shank

EASIEST ADJUSTMENT AND CALIBRATION

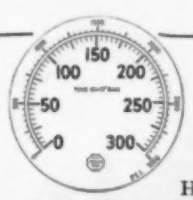
Only Helicoid Gages have the external pointer adjustment pictured here. The Helicoid type adjustment cannot be jarred out of position.

Calibration of Helicoid Gages is accomplished easily, without removing dial or pointer, because the link adjusting screw is at the rear of the system.

TUBES BUILT FOR MILLIONS OF PRESSURE PULSATIONS

To fit the wide range of applications, Helicoid Bourdon tubes are available in four materials—alloy steel, K Monel, stainless steel and phosphor bronze.

All Helicoid tubes are made from seamless tubing and are carefully designed to give maximum torque and minimum stress. When used within the dial range, they will withstand many millions of pressure pulsations and will not stretch, leak nor crack.



DOUBLE SCALE DIAL SHOWS TONS ON RAM AND PSI

Helicoid Gage dials are supplied in jet black with white figure markings or in dull white with black figure markings. They are constructed of laminated phenol with a transparent plastic surface and the longest possible scale length for more accurate readings. They are non-corroding, will not discolor nor fade and will not crack, chip nor peel.

Helicoid Gage Division
AMERICAN CHAIN & CABLE

929-H Connecticut Avenue • Bridgeport 2, Connecticut

ACCO

Helicoid gives you all these features at prices that are competitive in the quality gage field

T-J spacemaker cylinder

Quality Engineered

to give quality results

with Extras . . . at No Extra Cost!

You get more—much more—when you specify and use any of T-J's complete line of Spacemaker cylinders. The Spacemaker is engineered to give you better, more accurate, and longer service—offers, exclusively, many extras . . . that are STANDARD, AT NO EXTRA COST!

Designed to eliminate tie-rods, providing greater strength . . . saves space . . . reduces manhours and costs in all push-pull-lift operations. OFF SHELF DELIVERY in a wide range of styles and capacities, with 64,000 combinations. Write for catalog SM 56-2 with complete engineering details. The Tomkins-Johnson Co., Jackson, Mich.

T-J TOMKINS-JOHNSON
RIVETORS, AIR AND HYDRAULIC CYLINDERS, CUTTERS, CLINCHORS

METAL PISTON ROD SCRAPER . . . Standard at No Extra Cost!

NEW "SUPER" CUSHION FOR AIR . . . Standard at No Extra Cost!

CHROME PLATED CYLINDER BORES AND PISTON RODS . . . Standard at No Extra Cost!

ONE PIECE PISTON . . . Standard at No Extra Cost!

NEW "SELF-ALIGNING" MASTER CUSHION FOR HYDRAULIC USE . . . Standard at No Extra Cost!

NO TIE-RODS TO STRETCH . . . Standard at No Extra Cost!

STREAMLINED DESIGN . . . Oil Pressure to 750 P.S.I.—air to 200 P.S.I. Standard at No Extra Cost!

FORGED SOLID STEEL HEADS . . . Standard at No Extra Cost!

CIRCLE 100 ON PAGE 97

ONLY Eastman

CAN GIVE YOU THIS COMBINATION...

EXCLUSIVE EASTMAN PACKAGE

1 ***Exclusive*** **Eastman Inter-Lock® Clamp for Best Hose Connection.**

Exclusive grip advantages offered in no other clamp. Accurate machining assures positive positioning. Hose is uniformly compressed between insert and clamp without pinching or weakening, creating Eastman's exclusive "Inter-Lock" grip.

2 **Eastman Split Flange for Tighter Seal at Higher Pressures.**

Cuts production and replacement costs with a No-Thread, No-Leak "O" Ring Connection which eliminates tapered threads, sealing compounds and spiral leaks—as well as housing distortion.

Only Eastman can give you this Split Flange Clamp and exclusive Inter-Lock Coupling Combination. *Only* when you specify Eastman can you get the advantages of both. *Only* Eastman can give you this convenient one-source package.

This combination is ideal for *Original* heavy duty equipment. It is the only answer to high pressure requirements because it meets highest OEM specifications and easy field replacement needs.

Available with stem inserts in angles from 0° thru 90°; sizes from ¼" thru 2"; recommended pressures from 375 p.s.i. to 5000 p.s.i.

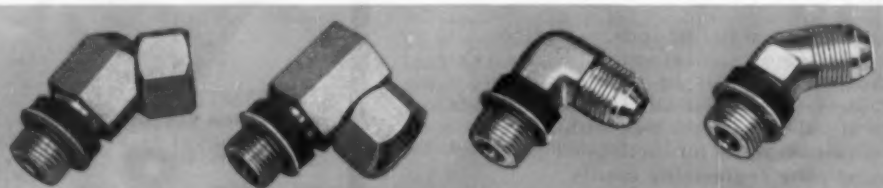
Look to Eastman . . . America's No. 1 OEM specification . . . for all your fluid power line requirements . . . for the best assembly, the best performance, the best service. Eastman is also recognized for its leadership in engineering design and development . . . backed by unequalled years of experience in the field. *It pays to submit your original specifications for your first quotation to Eastman!*

EASTMAN SPLIT FLANGE

Eastmon offers you the famous patented split flange design which assures a tilt and blowout proof clamp. "The higher the pressure the tighter the 'O' Ring seal."

Eastman "O" Ring Boss Fittings

Now available with new "Back-up" washer and locknut eliminating "O" Ring extrusion per SAE specifications.



Eastman
first in the field

Manufacturing Company
Dept. AH-2
Manitowoc, Wis.

DESIGN AND DEVELOPMENT ENGINEERS:

Write for Technical Bulletin 200 for Information and Specifications on Complete Eastman Line of Hydraulic Hose Assemblies, and Bulletin 40 on Inter-Lock clamp.

CIRCLE 32 ON PAGE 97

LETTERS
to the editor

Address your letters to: Editor, APPLIED HYDRAULICS Magazine, 812 Huron Rd., Cleveland 15, Ohio.

Central Accumulator Systems

We are faced with a problem concerning a large company which wants to run a battery of die casting machines from a central accumulator system. We noted in APPLIED HYDRAULICS that in December of 1951 such a system was explained for scrap collecting in a steel mill, in an article written by L. Melcarek.

Please send a reprint of this article plus any other information that pertains to our problem.

R. W. GERHARDT
Product Manager, Die Casting Div.
Hydraulic Press Mfg. Co.
Mount Gilead, Ohio

We've sent a reprint of "A New Approach to the Design of Central Hydraulic Systems" May, 1954. It should help you. The report on components for water hydraulic systems on page 63 of this issue should also be helpful. We'll do our best to answer any specific questions about central accumulator systems or tell you where you can get the answers.

Training Aids

Do you know of any source of training aids, films or slides covering basic hydraulics which we could use in training sales and demonstration personnel?

R. T. MCMILLAN
Engineering Dept.
Acme Machinery Co.
Williamson, West Virginia

A copy of a film and book list from the 1958/59 Fluid Power Directory has been sent.

Control & Drive Systems Reference

Will you please furnish us the name and publisher of a book

Continued on page 16

You get stronger, longer-lasting components with

SHENANGO CENTRIFUGAL CASTINGS

Even under the severest hydraulic service, you'll always get peak performance from Shenango centrifugally-cast components. They have a uniform, *pressure-dense* grain which makes for unusual strength and wearability. They are remarkably free from inclusions and porosity. And you'll find a *minimum* of machining is needed to attain a *maximum* of finish.

Shenango offers you cylinders and all symmetrical components in a wide range of sizes, shapes and dimensions . . . in most any non-ferrous metal or tough Meehanite metal . . . and rough-machined *or* finished to your exact specifications.

Shenango also offers a broad range of centrifugally-cast tubular bar stock to meet standard *and* specialized requirements.

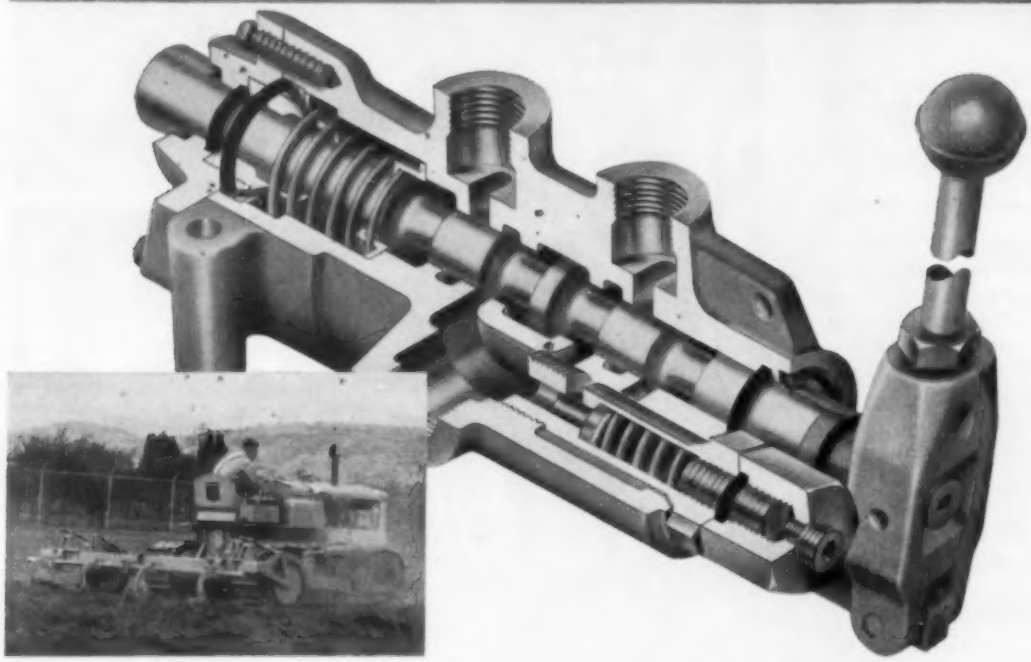
For the full story on Shenango's modern centrifugal casting process and products, write to: *Centrifugally Cast Products Division,* The Shenango Furnace Company, Dover, Ohio.

SHENANGO CENTRIFUGAL CASTINGS

COPPER, TIN, LEAD, ZINC BRONZES • ALUMINUM AND MANGANESE BRONZES
MONEL METAL • NI-RESIST • MEEHANITE® METAL • ALLOY IRONS

CIRCLE 88 ON PAGE 97

NATIONAL OIL SEAL LOGBOOK



Use of O-rings as moving seal in heavy duty bulldozer control valve

1,500 psi variation without backup rings. Intermittent operation plus long periods of inactivity. Extreme external dust and dirt conditions. Irregular and unpredictable field servicing. Fluid oil temperatures reaching 180°F. Climatic temperature extremes from —30° to +120°F. Life expectancy is required to be that of the tractor.

Above are the rugged operating conditions faced and met by National industrial O-rings in the new Be-Ge Model SU-1200F bulldozer blade control valve. A total of four rings are employed in each unit; two in a moving shaft application and two as static seals.

Be-Ge reports no leakage or ring failure on hundreds of heavy duty applications involving Oliver, Caterpillar, International Harvester and other crawler tractor installations.

National offers a complete line of industrial O-rings, plus many exclusive compounds. Special compounding is also available to meet unusual conditions.

For complete information on National O-Rings, or for skilled O-ring engineering service, call your nearest National Seal engineer. In major cities nationwide. See the Yellow Pages, under "Oil Seals".

Syntech® Oil Seals

Syntech oil seals, developed by and offered exclusively by National, are widely used synthetic rubber seals for applications where temperatures reach 250°F, speeds reach 3,600 FPM, and total indicator runout is as high as .030. Basic 50,000 series Syntech (illustrated) employs a tough, accurately manufactured steel outer case, precision-tensioned spring and accurately molded and trimmed Syntech sealing lip.

Micro-Torc Oil Seals

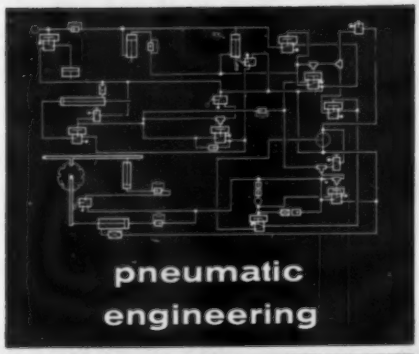
Micro-torc oil seals, pioneered by National, are sturdy, dependable leather seals. Special elastomer coating on *surface* of chrome re-tanned leather sealing lip prevents seepage of oil. Yet inner body of sealing lip retains natural porosity to "store" lubricant against accidental periods of starvation. Inherent lubricity of elastomer coating produces a lower torque, longer lasting, economical oil seal. Available in a wide variety of types and sizes.

NATIONAL SEAL
Division, Federal-Mogul-Bower Bearings, Inc.
General Offices: Redwood City, California
Plants: Van Wert, Ohio, Redwood City and Downey, California

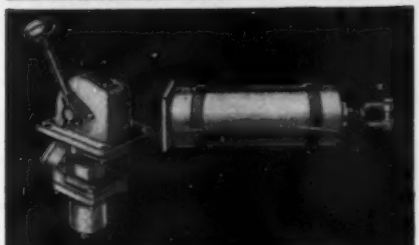
4624

CIRCLE 68 ON PAGE 97

Get them all from one reliable source!



pneumatic engineering



pneumatic control equipment

worldwide service

Get

WESTINGHOUSE PNEUMATIC CONTROL

89 YEARS OF EXPERIENCE—In designing, building, and improving pneumatic control systems. You get the benefit of that experience when you specify Westinghouse Pneumatic Control. Westinghouse specialists will help you with the design or application of pneumatic controls in your work.

A COMPLETE LINE—From simple on-off devices to pressure-control valves that can combine three or more functions in one lever. All are available from one experienced manufacturer—Westinghouse Air Brake Company.

GOOD DELIVERY, GOOD SERVICE—From Westinghouse you get distributor service and complete engineering service anywhere in the world—from Westinghouse or its affiliates overseas. Send coupon for more information.

89 YEARS OF
PNEUMATIC ENGINEERING EXPERIENCE

Confidence—the world over

Westinghouse Air Brake
COMPANY
Industrial Products Division
WILMERDING PENNSYLVANIA

FREE PNEUMATIC CONTROL DATA—This new booklet covers the basic fundamentals of pneumatic control engineering, based on Westinghouse's 89 years of work in this field.

Westinghouse Air Brake Company
Industrial Products Division, Dept. AH-28
Wilmerding, Pennsylvania

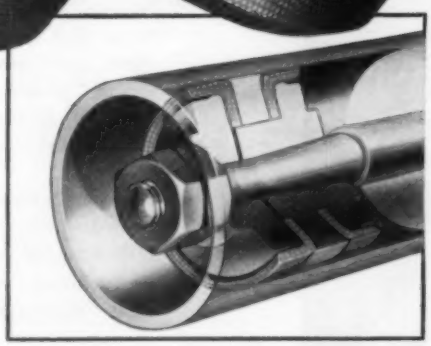
NAME .....
TITLE .....
FIRM .....
ADDRESS .....
CITY ..... STATE .....

PUMCUP ADVANTAGES

now yours for

- HYDRAULIC CONTROLS
- AIR CYLINDERS
- RECIPROCATING PUMPS

Two common Pumcup types: conventional and 45° bevel type . . . available in a complete range of sizes and texture-engineered compositions.



Cutaway view of typical Pumcup installation resulting in prolonged high efficiency.

TAKE it from experienced users, Darcova Pumcups offer payoff advantages that can't be equalled! For example, they last many times as long as ordinary piston packing..and they *hold peak efficiency* from start to finish. Because of the resulting production and maintenance economies, plant after plant is standardizing on Pumcups.

Improved application of the cup principle does the trick. And Darcova Pumcups are *texture-engineered* in *a range of compositions* to meet most temperature-pressure-fluid conditions. And they are available in sizes and types exactly right for your particular equipment.

It will pay you to get *all* the facts. Just ask for Pumcup Bulletin No. 5503.

DARLING VALVE & MANUFACTURING CO.
Williamsport 15, Pa.

DARCOVA
THE ORIGINAL COMPOSITION CUP
TRADE MARK
PUMCUPS

LETTERS

which we can use as a reference in working with oil hydraulic control and drive systems.

K. A. RIDDLE
Rome Kraft Co.
Rome, Georgia

We believe that the best all around reference for hydraulic information is the Fluid Power Directory which contains a 224 page technical section. We have sent you information about the directory and a list of textbooks which may be of assistance.

Low Temperature Operation

Please send six copies of the article "Successful Low Temperature Operation of Hydraulic Systems" contained on pages 69-72 and page 100 of your November issue.

JOHN B. GOHEEN
Engineering Dept.
National Iron Co.
Duluth, Minn.

Copies of this article have been sent.

1958/59 Directory

Here are excerpts from letters received by AH editors from men who have copies of the new 1958/59 *Fluid Power Directory:*

. . . You and the publishers are to be congratulated on producing such a very fine and valuable edition of this Directory. Anyone interested in fluid power will certainly receive maximum benefit from its contents. The book is beautifully layed out, well printed, sturdy and contains no end of valuable information.

MORRIS E. STEWARD
Ass't Gen. Sales Mgr.
Tru-Flate, Inc.
Oakland, Calif.

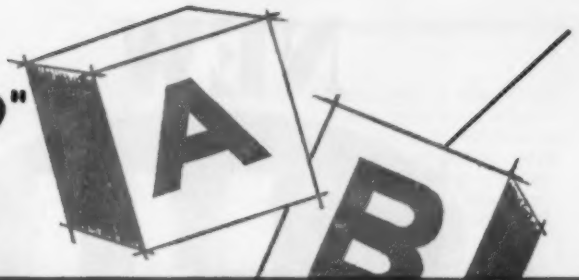
. . . you have every right to be justifiably proud of this new edition . . .

C. R. PITTMAN
Sales Manager
Hydraulic Power Div.
Hydraulic Press Mfg. Co.
Mount Gilead, Ohio

. . . I recently received my copy of the 1958/59 Fluid Power Directory and must compliment you

Continued on page 18

Tops in "CONTROLLED" Air Cylinder Power



The BELLOWS AIR MOTOR

The full story is yours for the asking-

Write for this free new booklet. Bulletin BM-25 gives detailed data and specifications that will enable you to decide for yourself how Bellows Air Motors will save you time and money.

Address Dept. AH-258, The Bellows Co., Akron 9, Ohio.

In Canada: Bellows Pneumatic Devices of Canada, Ltd., Toronto, Ont.

It's as simple as ABC — "control" is the essential difference that makes Bellows Air Motors do a better job at lower cost than conventional air cylinders.

In Bellows Air Motors control is an *integral part of* the air cylinder. There are no extra valves to buy — no complicated and cumbersome piping to install. The Bellows Air Motor is a complete power unit in itself.

What does it mean in terms of

- **BETTER PERFORMANCE?**
- **GREATER ECONOMY?**

It means instant action. The moment you shift the valve (either electrically or mechanically) the piston responds. No hesitancy — no chatter — no delay. It means simpler installation, easier interlock; "Controlled-Air-Power" fits in naturally with related machine movements. It means lower installed cost — lower maintenance costs.

618-B

The Bellows Co.

AKRON 9, OHIO

CIRCLE 14 ON PAGE 97

NEW fulflo

all-steel valve . . . for greater safety!

Install it . . . Forget it
For dependable pressure control

New Fulflo all-steel piston type, oil relief hydraulic by-pass valves combine proven features with the advantages of all-steel construction in flange models up to 2" pipe size. They are quiet, non-chattering because of shear-closing action. They offer greatest safety . . . even when subjected to extreme heat. Priced right for original equipment use . . . built right for superior replacement service.

THE FULFLO COMPLETE LINE

- Standard and flanged models
- Steel, cast iron or brass bodies
- Pipe sizes to 2½"
- Just 6 springs for pressures to 500#
- Brass, steel or stainless pistons
- *Specials* to your requirements

Specify FULFLO for Positive Automatic Pressure Control

Write for free helpful reference:
"FULFLO VALVES MECHANICAL DATA BOOK"

THE FULFLO SPECIALTIES CO., INC.
415 Fancy Avenue, Blanchester, Ohio

TRADE MARK "FULFLO" REG. U.S. PAT. OFF.

LETTERS

on the manner in which the information has been compiled and presented. It should be very useful to users of hydraulic and pneumatic equipment and components.

A. J. KOCH
Purchasing Agent
R. McDougall Div.
Upton Bradeen & James Ltd.
Galt, Canada

. . . not only have you done a splendid job in preparing the directory in such a way that it can really serve for reference purposes and therefore will be retained, but you have done a good job of getting it into the hands of people who will help the hydraulic industry.

DENISON NEALE
Director of sales
Denison Engineering Div.
American Brake Shoe Co.
Columbus, Ohio

. . . your Directory will occupy a front position in my personal reference file of manuals in daily use.

A. L. CANEY
General Sales Manager
Tuthill Pump Co.
Chicago, Ill.

. . . a comprehensive coverage of hydraulics which we have been searching for, for several years.

D. R. BUTTERFIELD
Farm Equipment Dept.
Montgomery Ward
Chicago, Illinois

. . . I am most pleased with my copy of the 1958/59 Fluid Power Directory. We shall put it to good use.

V. A. OLSON
American Engineering Co.
Philadelphia, Penn.

. . . The Directory will have a place in the bookcase which sits along side my desk and is very necessary in the direction of the sales work for our products.

H. W. WHITAKER
Sales Manager
Pump Div.
Eastern Industries, Inc.
Hamden, Conn.

For more information about the Directory see page 126.

CIRCLE 35 ON PAGE 97

Fastest in-the-field replacement!

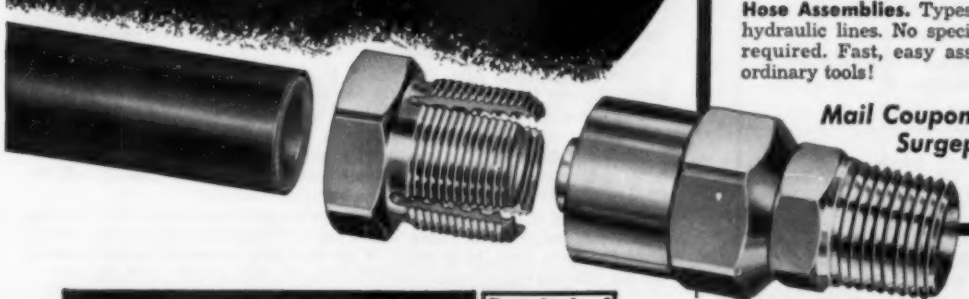
First choice for original equipment!

The Complete Line of

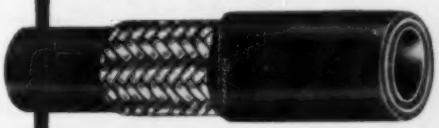
ALEMITE SURGEPRUF

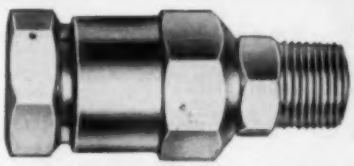
REUSABLE COUPLINGS AND HYDRAULIC HOSE

...with a full line of components nationally available!

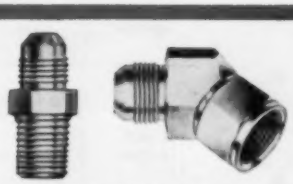


Single- and Double-Wire Hose For Medium-High Pressure and High-Pressure Service. Seamless inner tube of synthetic rubber, reinforced steel wire braid, and synthetic rubber outer cover. Resists abrasion, weather, and oil. Hose temperature operating range: —40° F. to +275° F.





Couplings. Made of high-strength steel. "Double-wedge grip" forces coupling threads through rubber cover . . . grips either single- or double-wire braid firmly. Saves both time and labor!



Adapters and Swivel Adapters. Full range of sizes in J.I.C. and other threads. One-piece adapters—and swivel union adapters to simplify assembly and avoid twisting strain in cramped quarters.

Hose Assemblies. Types and sizes for all hydraulic lines. No special assembly tools required. Fast, easy assembly with just ordinary tools!

Mail Coupon for Surgepruf Catalog!

ALEMITE
DIVISION
STEWART-WARNER
CORPORATION

Symbol of **SW** Excellence

1850 Diversey Parkway, Chicago 14, Illinois

ALEMITE, Dept. EE-28
1850 Diversey Parkway, Chicago 14, Illinois

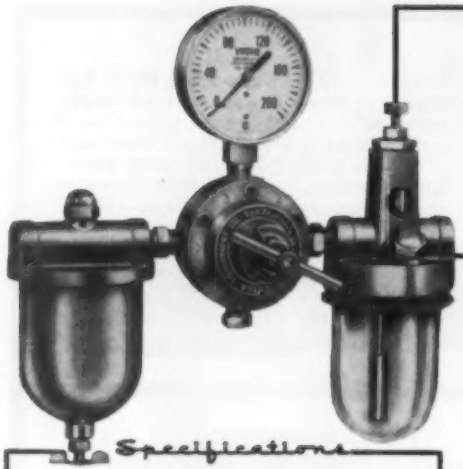
Please send me your catalogs of Surgepruf couplings, hose and components.

Name_____

Company_____

Address_____

City_____ Zone_____ State_____



PNEUMATIC CONTROLS BY VICTOR

FOR AIR-OPERATED TOOLS AND MACHINERY

FILTER Reliable operation of air equipment is dependent on removal of dirt, pipe scale and condensation from the air supply.

1. **A Porous Sintered Bronze** element provides maximum impurity trapping action with minimum air flow resistance (approximately 3 p.s.i. per 10 c.f.m.).
2. **Inlet Designed** to deflect the incoming air in a downward spiral motion to trap condensation and impurities which are removed through the petcock at the bottom of the bowl.
3. **Readily Disassembled** for complete cleaning by the removal of the top body nut.
4. **Available With Steel or Plastic Bowl.** Metal bowl is recommended for installations involving rough usage. The tough, durable plastic bowl is desirable because it provides full view of filtering action, showing condition of the air line and when to drain filter.

REGULATOR The VICTOR A-250 and A-375 Air Regulators are for reducing supply line pressures to required operating pressures and maintaining a constant pressure and flow of air to cylinders, pneumatic tools, and other types of air equipment.

1. **Self-Relieving Feature** protects equipment from over-pressure and permits relieving of delivery pressure by backing off the adjusting screw.
2. **Minimum Pressure Drop** is provided by a siphon port in the low pressure chamber which increases diaphragm response to delivery pressure demands.
3. **Freedom From Chatter** is made possible by a new design using a special "O" ring guide in the seat holder which effectively dampens out vibration under flow conditions.
4. **Simple, Sturdy Housing** of quality treated aluminum provides full strength and service without unnecessary weight. Internal parts are designed for simplicity and long life. Regulators laboratory tested millions of cycles, to insure trouble free operation under working conditions.
5. **Maximum Trouble-Free Diaphragm Life** is assured by the use of highest quality neoprene that will not separate or rupture.
6. **Trouble-Free Seat Life and Full Air Flow** is assured by an exclusive seat and nozzle design utilizing a precision molded half round neoprene seat against a flat face nozzle.
7. **Valve Seat Assembly Readily Accessible** for inspection by removing back plug.
8. **Sturdy Adjusting Screw** with smooth rolled threads, operates through a steel insert bushing. A lock-nut is provided for holding pressure settings. Adjusting screw can also be wire sealed through convenient tabs on bonnet to conform to JIC pneumatic standards.

LUBRICATOR The VICTOR Lubricator provides a dependable and accurate source of wear-protecting lubrication for all types of air equipment such as chucks, screw drivers, grinders, hoists, chipping hammers, air cylinders, etc.

1. **Visual Setting** of the lubrication rate results in correct oiling without guessing. The precision needle valve provides a wide range of accurate and consistent oil flow to the air line under operating conditions.
2. **Reliable Lubrication Rate.** The VICTOR Lubricator is designed to eliminate air locking and over feeding of oil into the line when the air flow stops or fluctuates. A filter in the oil feed line insures a constant flow of clean oil to the metering valve at all times.
3. **The Visual Oil Supply Cup** is made of a durable and tough plastic with a safety factor of 5 times the recommended maximum working pressure of 125 p.s.i. It has a 1/3 pint capacity.
4. **Oil Cup Easy to Fill.** Refilling can readily be accomplished through the filler plug without shutting off the air supply. The oil cup can be removed for cleaning or filling without shutting down the air supply, if the filler plug is removed before loosening the cup retaining nut.

No. 44

Specifications

MODEL COMBINATIONS

	MODEL	WEIGHT
FRL	FRL-250	5 lb. 14 oz.
	FRL-375	5 lb. 14 oz.
	FRL-250P	5 lb. 14 oz.
	FRL-375P	5 lb. 14 oz.
FL	FL-250	3 lb.
	FL-375	3 lb.
	FL-250P	3 lb.
	FL-375P	3 lb.
F	F-250	1 lb. 7 oz.
	F-375	1 lb. 7 oz.
	F-250P	1 lb. 7 oz.
	F-375P	1 lb. 7 oz.
FR	FR-250	4 lb. 5 oz.
	FR-375	4 lb. 5 oz.
	FR-250P	4 lb. 5 oz.
	FR-375P	4 lb. 5 oz.
R	A-250	2 lb. 14 oz.
	A-375	2 lb. 14 oz.
RL	RL-250	4 lb. 7 oz.
	RL-375	4 lb. 7 oz.
L	L-250	1 lb. 9 oz.
	L-375	1 lb. 9 oz.

All 250 Models have ¼"-18 NPT(F) Inlet and Outlet Connections.

All 375 Models have ⅜"-18 NPT(F) Inlet and Outlet Connections.

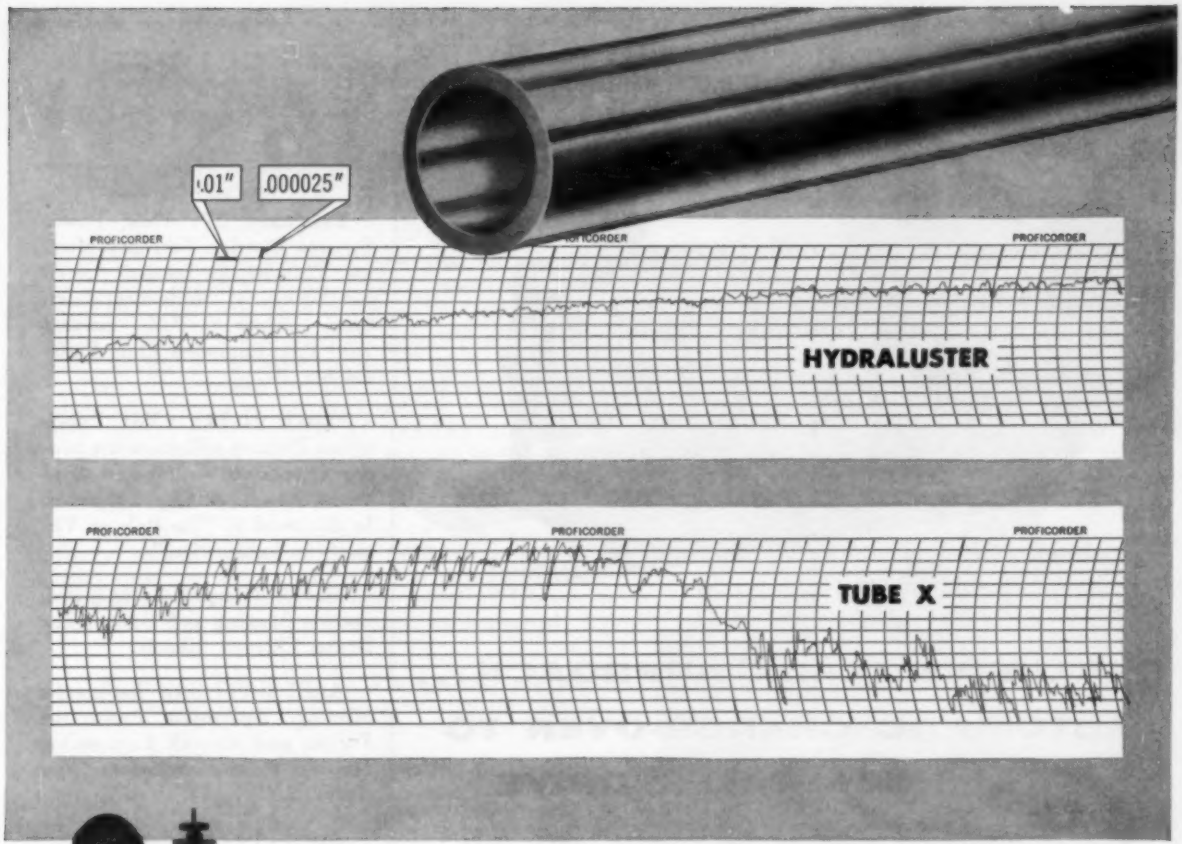
NOTE: All Filters, Regulators, and Lubricators listed have left hand inlets. If right hand inlet is desired, place "R" after the model number.

VICTOR for welding

VICTOR EQUIPMENT COMPANY

Mfrs. of welding & cutting equipment; hardfacing rods, blasting nozzles; cobalt & tungsten castings; straightline and shape cutting machines.

844 Folsom St., San Francisco 7 • 3821 Santa Fe Ave., Los Angeles 58



VERIFICATION: Measurements of Hydraluster and Tube X were made on The Proficorder—an instrument of our manufacture for accurately showing the true profile of practically any machined or finished surface. The tests were conducted in our laboratories under my personal supervision. And I verify that both tubes were measured under identical conditions. The resulting graphs show the exact differences in the samples furnished. **Douglas Palmer — Chief Inspector, Micrometrical Mfg. Co., Ann Arbor, Mich.**

In micro-inch comparison of hydraulic tubing . . .

HYDRALUSTER shows smoothest, most friction-free I.D.

These graphic red lines are recorded measurements showing a surface profile *inside* both HYDRALUSTER and a length of standard hydraulic tubing. *Both tubes were selected at random from warehouse stocks*, then accurately measured in microinches by the sensitive stylus of the famous PROFICORDER.

Hydraulic system efficiency and dependability, in a large degree, depend on factors illustrated by the red lines. Tube X is *not* a scrap piece of tubing. In fact, it represents a quality grade purchased and used every day. Which tube would you select to offer the least resistance to hydraulic flow . . . to transmit fluid with the least amount of pressure drop . . . and to create the least fluid turbulence?

Hydraluster is the answer, of course. And Hydraluster is the right tube to specify when you want to insure these same performance characteristics in your hydraulic systems.

SAMPLES AND SPECIFICATIONS: Examine Hydraluster finish yourself. Your name on company letterhead will bring specifications and a sample by return mail. *Hydraluster is sold at standard carbon hydraulic tubing prices.*

Summerill

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PITTSBURGH 30, PA. DEPT. NO. I-D1

District Offices: Buffalo • Chattanooga • Cleveland • Dayton • Hartford • Philadelphia • Pittsburgh • Milwaukee • Chicago • Los Angeles • San Francisco

CIRCLE 24 ON PAGE 97

6,000 psi continuous
10,000 psi intermittent

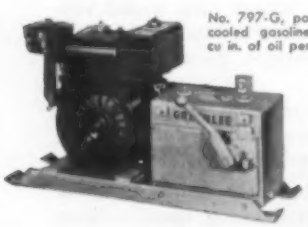
106 or 213 cu in. per min delivery at 10,000 psi

No. 797-E Hydraulic Power Pump with choice of 2-hp or 3-hp a-c electric motor

EXCLUSIVE QUICK APPROACH... AUTOMATIC CHANGE-OVER TO FAST HIGH-POWER DRIVE

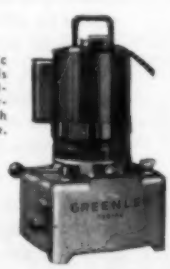
GREENLEE No. 797 Hydraulic Power Pumps readily apply to numerous rams, jacks, presses, and special hydraulic installations where high-speed, high-power operation is an advantage. Exclusive GREENLEE fast-approach feature eliminates nearly all time loss ordinarily accumulating while operators wait for the ram to contact the work! Change-over to drive speed is automatic at 6000 psi for smooth, fast, heavy-duty work. Delivers 106 cu in. of oil per minute at 10,000 psi when equipped with a 2-hp a-c motor — 213 cu in. with 3-hp a-c motor. Three-phase 60-cycle 220/440-volt motors; available gasoline-powered units are described below.

Fast hydraulic return of ram is available in every type GREENLEE power pump! All pumps available for either single-action or two-way-action rams.



No. 797-G, powered by 4½-hp air-cooled gasoline engine, delivers 106 cu in. of oil per minute at 10,000 psi.

No. 798 Portable Hydraulic Power Pumps feature two speeds for fast approach, develop 6000-psi continuous, 10,000-psi intermittent pressure. Equipped with a-c motor or gasoline engine. Easily carried by one man.



No. 768 Fast-Approach High-Pressure Hydraulic Hand Pump develops up to 10,000 psi.

TOOLS FOR CRAFTSMEN
GREENLEE

WRITE or attach this page to your letterhead for illustrated data on all these GREENLEE pumps. Our engineering department is equipped to help you on special applications.

GREENLEE TOOL CO., 2442 Herbert Ave., Rockford, Ill.

FUTURE EVENTS

February 27: Fluid Power Systems Division February Meeting, Philadelphia Section, American Society of Mechanical Engineers. Dinner 6 P.M., meeting 7:30 P.M. Engineers Club, Philadelphia, Pa.

March 10-11: ASME Lubrication Division will sponsor a two-day symposium at 150 East 42nd Street, New York City. Subject to be discussed is "The Role of Viscosity in Lubrication."

March 31-April 2: SAE Production Meeting and Forum, The Drake, Chicago, Illinois.

April 8-11: SAE Aeronautic Meeting, Aeronautic Production Forum, and Aircraft Engineering Display. Hotel Commodore, New York, N.Y.

April 14-17: Design Engineering Show, International Amphitheatre, Chicago. Write Clapp & Poliak, 341 Madison Ave., New York 17, for further details.

May 1-8: ASTE Tool Show, Convention Center, Philadelphia, Pa. For complete information write ASTE, 10700 Puritan Ave., Detroit 38, Mich.

June 2-4: National Fluid Power Association Annual Spring Meeting, Bedford Springs Hotel, Bedford, Pa.

June 9-12: American Society of Mechanical Engineers national conference on materials handling. Public Auditorium, Cleveland, Ohio.

September 29-October 3: ASTE Semi-Annual Meeting and Western Tool Show. Shrine Exposition Hall, Los Angeles, Calif.

October 16-17: NCIH 14th Annual Meeting. Sherman Hotel, Chicago, Ill. For complete information write Raymond D. Meade, Conference Secretary, Illinois Institute of Technology, Chicago, Ill. ▼▼▼

CIRCLE 41 ON PAGE 97

HERE'S ONE — MORE TO COME

New Skinner Valves at Low Prices

Here it is — one of the many new lines Skinner will bring you in 1958. A new 2-way, normally closed, pilot-operated valve that is lighter in weight — only 1 ¾ pounds — and smaller in size, yet permits full flow through a ½" orifice with ⅜" or ½" pipe taps.

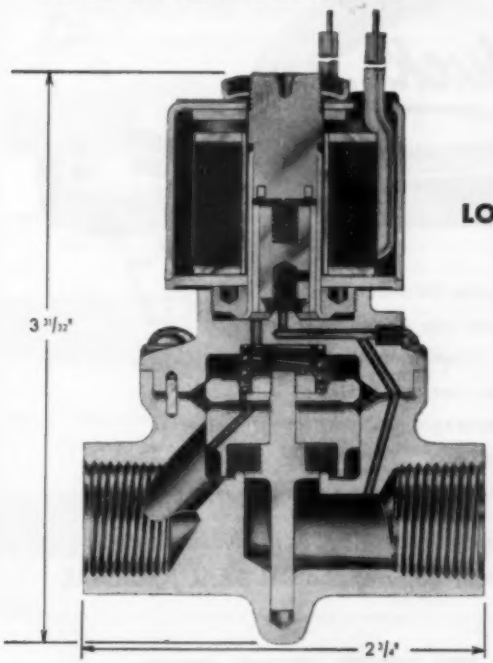
The valve handles pressures from 5 psi to 150 psi, with temperature ranges from —40°F to 180°F, and will operate on all popular AC and DC voltages. It's small but rugged, economical but efficient — manufactured to the highest engineering standards of the Skinner Valve line.

Versatility is also a feature of the new Skinner L Series; modifications are already available for normally open operation, with such options as manual override, explosionproof construction and choice of electrical connections to fit your application requirements.

* * *

You can get full details of this exciting, new valve line by writing us direct or by contacting the Skinner Representative or Distributor near you. He's listed in the Yellow Pages. Write Dept. 312.

2-way normally closed shown actual size.



LOOK AT THESE HIGH-QUALITY FEATURES:

- Unique Diaphragm Design — by actual test, this new design outperforms all others — the diaphragm is completely supported at all times. The nylon-reinforced buna diaphragm has a high resistance to media impurities, and only a small area is exposed to pressure, which assures long, trouble-free life.
- So Easy to Mount — so light in weight that it can economically mount directly to line.
- Operates upside down, sideways, in any position — strong spring action snaps valve shut — every time.
- Forged Brass Body — provides low porosity and dense metal structure for rugged application and no leakage.
- Low Wattage Consumption — coil consumes only 8 watts, considerably less than comparable valves.
- Soft, Synthetic Inserts — withstand constant opening and closing of pilot and main orifices — are long-wearing and provide absolute bubbletight operation.
- Internal Stainless Steel Parts — eliminate internal rusting, clogging or contamination.

SKINNER ELECTRIC VALVES
THE CREST OF QUALITY

SKINNER ELECTRIC VALVE DIVISION
NEW BRITAIN CONNECTICUT
105 EDGEWOOD AVENUE

CIRCLE 91 ON PAGE 97

Don't buy oil seals haphazardly. Get Pioneer Oil Seals.
Pioneer representatives are factory trained men who can deal with any oil-sealing problem on the spot and recommend the seal you need.
Pioneer Personal Oil Sealing Service means not only studying a customer's individual needs; it also means recommending the right oil seals and personal inspection when they are in use.
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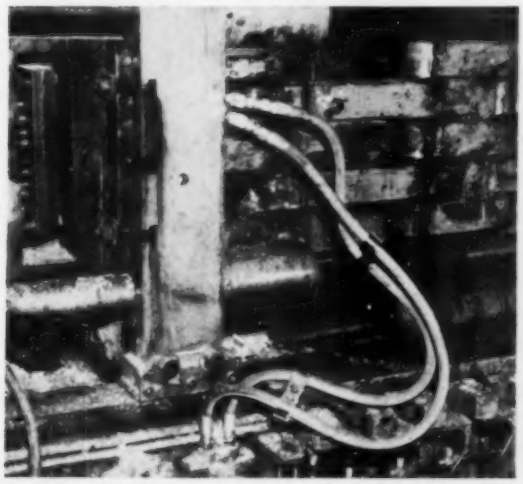
CIRCLE 73 ON PAGE 97

Select The Right Kind Of Hose For The Fire-Resistant Hydraulic Fluid You Use



Aeroquip 1546 Hose Lines convey fire-resistant hydraulic fluids on this die-casting machine.

AEROQUIP OFFERS A FULL RANGE OF HYDRAULIC HOSE AND REUSABLE FITTINGS FOR ALL FLUIDS

Fire-resistant hydraulic fluids, whether water-base or phosphate-ester base, offer safety and reliability in "hot spot" hydraulic systems. Yet, these two major types of fluids are not interchangeable.

For hydrolubes such as Ucon and Houghto-Safe 620, Aeroquip 1508, 1509 or 1503 Hose and Reusable Fittings are recommended.

When phosphate-ester base fluids like Cellulube, Pydraul F-9 and Houghto-Safe 1020 are used, Aeroquip 2756, 1546 or 1532 Hose and Reusable Fittings should be used. In addition to using one of these hose lines, it is recommended that compatible polymeric seals and packings also be used throughout the hydraulic system.

The chart below supplies basic information on Aeroquip Hose Lines for fire resistant fluids. Full technical information is available, with complete engineering assistance to manufacturers.

FOR HYDROLUBE FLUIDS	FOR PHOSPHATE-ESTER FLUIDS
Aeroquip 1508 Multiple Spiral Wire Wrap Hose for high pressure hydraulic systems operating up to 5000 psi. Temperature range —40°F. to +200°F. In ⅜", ½", ¾" and 1" O.D. tube sizes.	**Aeroquip 2756 Multiple Spiral Wrap Hose** for phosphate-ester hydraulic systems with high operating pressures to 5000 psi. Temperature range —40°F. to +200°F. In ⅜" through 1" sizes.
Aeroquip 1509 Double Wire Braid Hose for high pressure hydraulic systems ranging up to 5000 psi., depending on hose size. Temperature range —40°F. to +200°F. In sizes from ¼" through 2".	**Aeroquip 1546 Double Wire Braid Hose** for phosphate-ester hydraulic systems up to 5000 psi., depending on hose size. Temperature range —40°F. to +200°F. In sizes from ¼" through 2".
Aeroquip 1503 and 1502 Single Wire Braid Hose for medium pressure hydraulic systems up to 3000 psi., depending on hose size. Temperature range —40°F. to +275°F. In O.D. tube sizes from ¼" through 3".	**Aeroquip 1532 Single Wire Braid Hose** for phosphate-ester hydraulic systems up to 3000 psi., depending on hose size. Temperature range —40°F. to +250°F. In O.D. tube sizes from ¼" through 2".

Aeroquip

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INDUSTRIAL DIVISION, VAN WERT, OHIO • WESTERN DIVISION, BURBANK, CALIFORNIA

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CIRCLE 3 ON PAGE 97

FLUID POWER *Pioneers*

JAMES (JIM) ROBINSON

ANYONE who heard Jim Robinson speak knew he was born in Scotland. Educated at the Royal Technical College of Glasgow, he came to the United States in 1929, joining the engineering department of Vickers Incorporated in 1930. For eleven years he directed all phases of the company's engineering activities as Assistant Chief Engineer and Chief Engineer. At his death in December 1957, he was Director of Engineering, Machinery Hydraulics Division, Vickers Incorporated.

During his almost 30 years in the hydraulics field, Mr. Robinson saw it grow from a not very active toddler to a dynamic adult with jobs in almost every industry. He took an active part in many of the developments for airborne, mobile, marine, ordnance and machine tool applications. Many hydraulic power transmission patents are in his name.

He was in charge of much of the early development work on aircraft hydraulic units, including the first 3000 psi pump. Many early hydraulic devices used in fire control and on ordnance, particularly for the Navy, were his. Strip and paper mills use the drive he perfected to keep constant tension on reels.

He was very active in the formation of the Joint Industry Conference Hydraulic Standards, and, through his work with oil and chemical companies, promoted use of fire-resistant hydraulic fluids, particularly for the machine tool and die-casting fields.

Jim Robinson's work in the furtherance of fluid power is indicated by his part in association and technical society activities. He was a past Chairman, Hydraulics Standards Committee, National Machine Tool Builders' Association; a member of the Fluid Power Systems Sub-committee of ASME's Hydraulic Division; member, ASLE Technical Committee on Hydraulics and Hydraulic Machinery; member, AIA Technical Committee on Accessories and Equipment; member of the Society of the Plastics Industry Executive Committee on Fire Prevention. Jim also belonged to ASTE, SAE, AOA, Engineering Society of Detroit, Industrial Mathematics Society and the Aero Club of Michigan.

We'll all miss him.

the man from Webster...

on your team but on our PAYROLL!

Sound ideal, doesn't it? In practice, it's even better. When you call the man from Webster, you add another expert to your team — a specially trained hydraulics engineer. He knows how to make hydraulics work most efficiently on your product. Another advantage too, is his wide experience with the Webster line of over 100 positive displacement, gear-type pumps and fluid motors . . . standard equipment on products with a reputation for dependability, high performance.

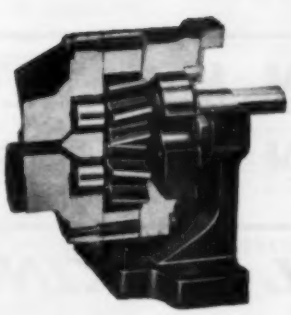
Write or call the man from Webster — a good man to have on your team.

OIL HYDRAULICS DIVISION

WEBSTER ELECTRIC
MELROSE 3-3511
RACINE · WIS

OVER 100 MODELS

Capacities: *1/5 to 30 GPM*
Pressures: *Up to 1500 PSI*
Speeds: *Up to 3600 RPM*
Drives: *Direct or Geared*
Torques: *Up to 60 in. lbs./100 PSI*
Available with or without built-in relief valves



H-107

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☐ *Complete hydraulic catalog of pumps and valves*

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CIRCLE 116 ON PAGE 97

ABSOLUTE ADHESION

BONDED BY IPC

IPC's bonding technique can mean money saved and a problem solved for you.

IPC has developed a special bonding process which provides *absolute adhesion* between rubber and metal in their bonded case seals and bonded washer seals. In tests much more severe than any normal application, the IPC "bond" would not break down.

This special process enables us to manufacture a finer oil seal with simplicity of design which means lower cost and improved performance.

IPC's custom bonding process is your protection against seal failure. For the answer to your particular sealing problem, contact IPC. Our "custom" approach to both design *and* manufacture is your assurance of greater savings and dependability.

PACKINGS / OIL SEALS / PRECISION MOLDING

IPC

BONDED BY IPC

1. Bonded Washer Seal Double Lip Wiper
3. Bonded Washer Seal Straight Lip
5. Bonded Washer Seal Straight Lip With Garter Spring
7. Bonded Case Seal Straight Lip
9. Bonded Case Seal Straight Lip With Garter Spring
11. Bonded Case Seal Straight Lip Thin Rind Type
13. Rubber Covered Bonded Case Seal Straight Lip
15. Rubber Covered Bonded Case Seal Straight Lip With Garter Spring
2. Bonded Case Seal Double Lip Wiper
4. Bonded Washer Seal Limited Contact Lip
6. Bonded Washer Seal Limited Contact Lip With Garter Spring
8. Bonded Case Seal Limited Contact Lip
10. Bonded Case Seal Limited Contact Lip With Garter Spring
12. Bonded Case Seal Limited Contact Lip Thin Rind Type
14. Rubber Covered Bonded Case Seal Limited Contact Lip
16. Rubber Covered Bonded Case Seal Limited Contact Lip With Garter Spring

INTERNATIONAL PACKINGS CORPORATION
Bristol, New Hampshire

P1

CIRCLE 54 ON PAGE 97

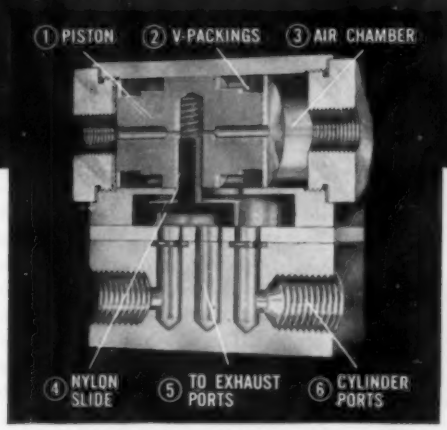


Diagram shows air flowing to one side of a double acting cylinder from outlet 6 while being exhausted through hole 5 on other side of cylinder. When the right poppet is touched, air is bled from chamber 3 and piston(1) is shifted to right. At this point, air is exhausted through port 6 as air enters opposite side of cylinder.

Here at last is the air valve which makes "automation with air power" absurdly simple. No expensive, delicate electrical circuits are needed! It's air pressure alone—distributed through slender, flexible hose—that does the work with the same instantaneous response of electricity.

A light momentary touch on the miniature limit switch actuates the main valve piston, which moves from side to side like a shuttle, clearing first one air passage and then the other. The piston is moved by releasing the air on one side through the limit switch. Regardless of amount of air pressure, a featherweight touch releases air, shifts piston.

The limit valves can be mounted at points where they will be tripped by the moving parts of a working machine, such as the ram of an air cylinder, the moving table of a milling machine, the depth stop rod of a drill press, or a revolving cam on a shaft.

Cost-saving possibilities are almost unlimited! Now clean, quick, dexterous air power can be directly integrated with mechanical functions of many production machines. New worlds open to original equipment manufacturers!

Let us help with your problem. If you have a possible application for **MEADMATIC** valves, timers or cylinders, tell us (confidentially) and we'll try to come up with the answer. Write for Air Power Catalog!

Write today for Air Catalog!

MEAD
SPECIALTIES COMPANY

PATHFINDER IN AIR **POWER AUTOMATION**

CIRCLE 65 ON PAGE 97

BRIEFS

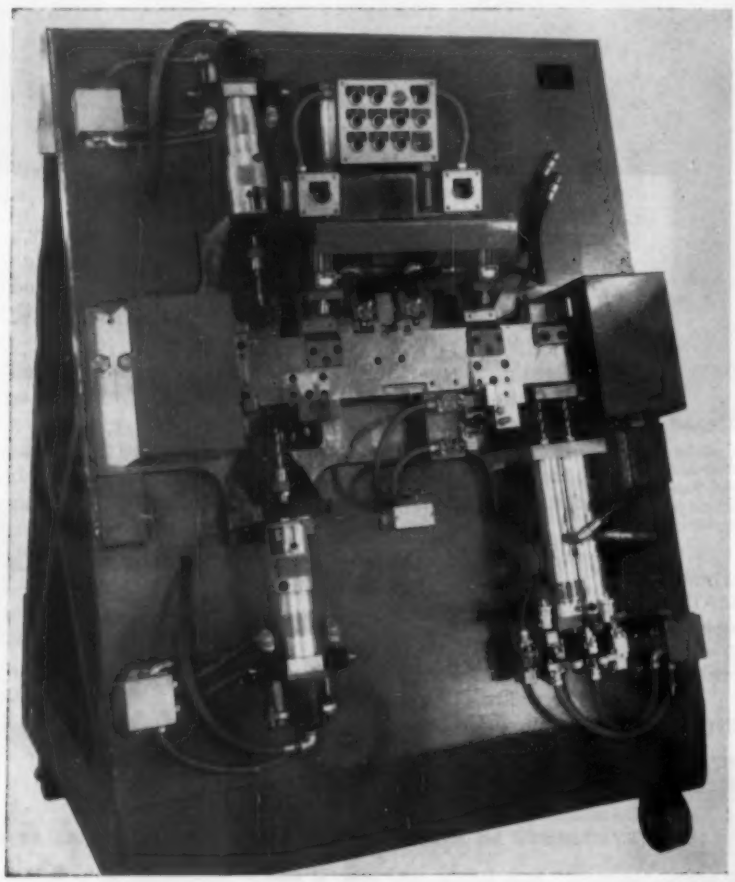
about fluid power

"WAFFLE IRON" RADIATOR GRILLES GET DRILLED WITH AIR

Those new Buick grilles are die castings which call for a neat tooling set-up to drill and countersink six holes at cost-cutting, high-production rates.

Because of close spacing of two sets of holes and the large drill unit housing needed, indexing of the workpiece is necessary. The remaining two holes are spaced differently and are serviced by individual drill units.

• **Electric control**—Automatic indexing is controlled by a panel of 18 relays working with 12 signalling limit switches. The push-button control panel includes start and stop, and three-position Off-Manual-Automatic switches. Separate push-button switches individually operate each drill unit, index the slide, or actuate the clamp members for machine alignment or adjustments. The "automatic" switch sets up the circuitry for automatic operation.



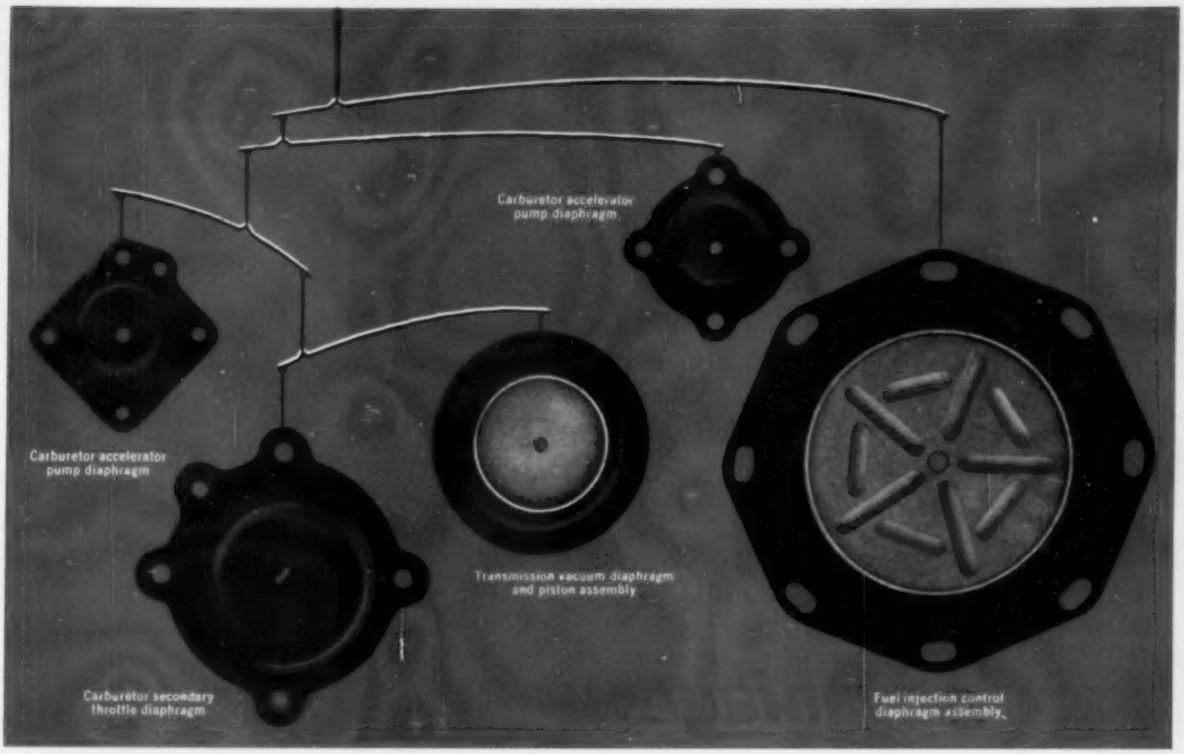
• **Air cylinders**—The grille is clamped by four air cylinders. Indexing is powered by a double-acting air cylinder. The drills are air motor driven and fed. A work cycle can be completed in four seconds. The machine is manufactured by J. C. Thompson Tool and Die, Inc., Fort Wayne, Indiana. ▼▼▼

ASME Discusses Nautilus

Hydraulics on the U.S.S. Nautilus, first atom sub, was the subject at the New York ASME Hydraulic Section Meeting, January 8th. Walter Tisdale of Electric Boat Co., Groton, Conn., described the Nautilus' systems as the latest in reliability, efficiency and ease of control. The sub has several independent hydraulic systems. If the main system fails, the alternate systems can be brought into operation. In addition to the internal systems, there is an external system which operates a number of devices outside the hull. In a question-and-answer period, members asked questions about accumulator, valve and cylinder construction, O-ring experience, type of fluid used, filtration methods, leakage problems and manifolding in the Nautilus' design.

The next Hydraulic Section meeting will be held March 12, 1958, at the Consolidated Edison Building, 4 Irving Place, Rm. 1421, New York City. ▼▼▼

Continued on page 32


Carburetor accelerator pump diaphragm
Carburetor accelerator pump diaphragm
Transmission vacuum diaphragm and piston assembly
Carburetor secondary throttle diaphragm
Fuel injection control diaphragm assembly

Need Critical Diaphragms?

C/R will design, compound and mold them to your exact specifications

Simple or complex, your diaphragm problem can be solved quickly, dependably with the help of C/R Sirvene engineers. Their specialized experience gained in the solution of hundreds of similar problems is yours to use. They will design and compound the correct elastomers to produce the exact degree of hardness, tensile strength, compression set, volume change and flexibility you require. Temperature resistance, with various materials, ranges from —100° to 500°F., and compatibility with an equally broad range of fluids, gases and solids, including petroleum base fuels and synthetic hydraulic oils can easily be achieved.

Whether you specify critical tolerances, exact concentricity or flawless bonding—the more reason to assign full responsibility to C/R Sirvene engineers. They'll assure the absolute uniformity and quality of your diaphragm straight through production. Define your diaphragm problem to us and see how we can help.

Write for your copy of the illustrated Diaphragm Bulletin SD-100.

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Offices in 55 principal cities. See your telephone book.
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CHICAGO RAWHIDE

CIRCLE 22 ON PAGE 97

SECO
ISO-FLO
PUMP

Advantages

- Several *isolated* flow outputs from one pump.
- Separate pressure control of these several outputs is accomplished without complex flow control or reducing valves.
- High flow, low pressure . . . and low flow, high pressure from one pump.
- Ideal for accumulator circuits . . . Does not require delicate and unpredictable automatic unloader valve . . . Eliminates constant cycling.
- Automatic unloading characteristics permit large savings in horsepower, and greatly prolonged bearing life.
- ISO-FLO pumps will accomplish most cut-back or clamping operations better than a variable displacement pump—and at lower cost.
- Ideal for parallel feed of cylinders.
- Output of one piston may be used to control the function or cycling of remaining pistons.
- Great flexibility of flow rates is obtainable simply by adding or removing pistons.

Available in models with 7 or 14 pistons. Capacities ½ to 10 G.P.M. Operating pressures over the entire 0 to 10,000 PSI Range.

SECO

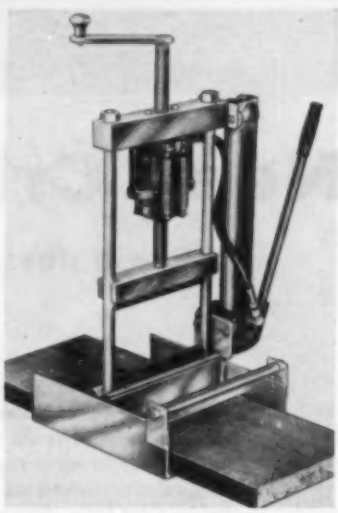
SIMPLEX ENGINEERING CO.
Subsidiary of RACINE HYDRAULICS & MACHINERY, INC.
ZANESVILLE, OHIO

BRIEFS

Smoother Elevator Stops

Two-way leveling mechanism for oil-hydraulic elevators is an integral part of a "unitized" hydraulic control device. Oil valves which control the movements of the elevator are combined within one housing, eliminating the usual series of valves connected by piping.

The leveling feature causes an elevator traveling upward or downward to decelerate at a given distance before reaching a floor level, provides a smooth and accurate stop. The system's accuracy is unaffected by variance in oil line pressure caused by very light or heavy loads on the elevator platform. The controller is externally adjustable and all normal maintenance can be performed without disassembly. Units are manufactured by Rotary Lift Co., Memphis, Tenn. ▼▼▼



NEW USE for portable hydraulic power is this stone cutter. Two cylinders apply 17½ tons to drive two 1-inch square blades. A 10,000 psi handpump supplies the power. Tru-Split Tool Company, Winona, Minn., builds the cutter.

Continued on page 34

CIRCLE 89 ON PAGE 97

CIRCLE 40 →

EXCLUSIVE

GITS MATCHED-SET AIR LINE LUBRICATION

To meet modern industry's growing demand for better air line lubrication, this complete "matched-set" line of Air Line Lubricators, Filters and Regulators offers an exclusive combination of important advantages, including:

REDUCED INVENTORY. Only 1 size handles any air line in the plant up to ¾" pipe size.

INSTANT MONITORING by Gits Mist-a-Dome.

MINIMUM PRESSURE DROP, regardless of volume of air: a result of Gits By-Pass Valve.

FLEXIBILITY. Can lubricate from ¾ to 90 cubic feet of air per minute.

Get full details. Send for this **NEW FREE CATALOG**

GITS BROS. MFG. CO. *Pneumatics Division*
1846A South Kilbourn Avenue, Chicago 23, Illinois

450 GPM

New 4" Solenoid operated Pilot Controlled Four-way valve handles 450 gpm at 15 ft/sec. Six spool types with adjustable choke pilot end covers.

This ⅛" four-way valve is the smallest in the H-P-M line and handles 2 gpm at 15 ft/sec. velocity. Six spool types.

BIG or small H-P-M gives You One Source for Complete Satisfaction

Whatever your needs, H-P-M has the experience and the hydraulic components to handle your requirements. Big or small—standard or special—call your H-P-M Hydraulic Power specialist in your area or write headquarters at Mount Gilead. Valves to 700 gpm also available.

H813

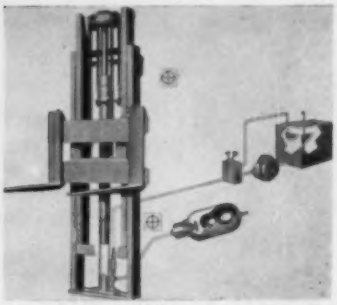
HPM

HYDRAULIC POWER DIVISION
THE HYDRAULIC PRESS MFG. COMPANY
A DIVISION OF KOEHRING COMPANY • MOUNT GILEAD, OHIO, U. S. A.

BRIEFS

Accumulator Cuts Shock Impact 50%

A lift truck is subject to severe shock and vibration as it travels over uneven surfaces. These shocks are transmitted throughout the complete truck structure resulting in increased maintenance and shorter truck life besides subjecting loads to unnecessary jolts and jars. Under



Courtesy Yale & Town Mfg. Co.

conditions such as railroad crossings shocks as high as 4 to 1 have been recorded with non-pneumatic tired trucks. Shock impacts on hydraulic lift trucks can be reduced by more than half by placing an accumulator in the hydraulic line between the hoisting cylinder and control valve. An accumulator soon pays for itself by cutting down truck maintenance and load spillage and breakage. Although it plays a more important part on non-pneumatic tired trucks, an accumultor will supply additional cushioning with pneumatic tires. In the photo, installation of the accumulator is shown between the flow control valve and the lift cylinders. ▼▼▼

Hydraulic Power Packs Provide Flexibility

Three separate hydraulic power packs power the way-type machining units of four machining stations on this multiple operation machine. Fifty different universal joint flanges are faced, bored, counterbored, undercut, drilled and chamfered on the rotary index special machine designed and

Continued on page 38

CIRCLE 52 ON PAGE 97

CIRCLE 66 ⟶

Save 27% or more in cost...

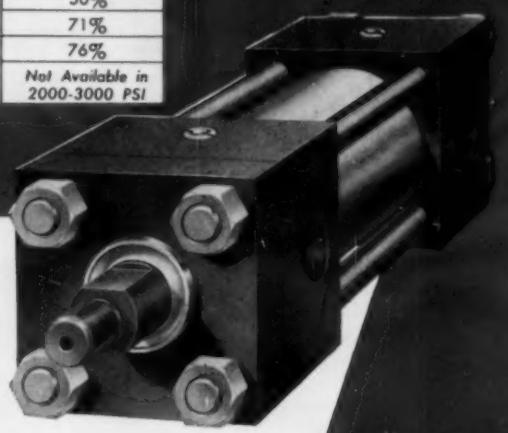
NEW

Miller

"JOB RATED"

HYDRAULIC CYLINDER LINE

JOB RATED, MODEL "LH"			
BORE	CONTINUOUS SERVICE RATING	INTERMITTENT SERVICE RATING	YOU SAVE THIS % IN PRICE OVER STANDARD 2000-3000 PSI CYLINDERS
1½"	1500 PSI	2500 PSI	27%
2	1500	2500	27%
2½	1000	1500	28%
3¼	1500	2500	32%
4	1000	1500	35%
5	800	1200	37%
6	800	1200	43%
8	500	800	50%
10	500	800	71%
12	500	800	76%
14	500	800	*Not Available in 2000-3000 PSI*



with IDENTICAL seals, design, and safety factors as the famous Miller "Power-Packed" Model "H" Line for 3000-5000 psi service.

ALL TEFLON* SEALED AGAINST EXTERNAL OIL LEAKAGE

SHEF SEAL
At Tubing Ends

Has zero axial clearance, metal backup, no "blind assembly." Teflon sealing strip of one cross-section dimension for all cylinder sizes—supplied on convenient spools.

Shear-proof
Heat-proof
Extrusion-proof
Fluid-proof

Piston Rod Flange Seal

Self-regulating, wear-compensating piston rod flange seal is pressure-energized, guaranteed leak-proof and never requires adjustment.

Teflon rod wiper keeps dirt out. Teflon hydraulic wiper keeps lubricant in.

Teflon sealing strip for bushing is one cross-section dimension for all cylinder sizes — supplied on convenient spools.

LOCK-SEAL
Cushion Adjusting Screw

Non-protruding screw automatically sealed and locked by Teflon ring. Interchangeable with ball check assembly for easy access.

CASE-HARDENED CHROME-PLATED PISTON RODS

Heat treated, stress relieved, high tensile steel piston rods, case-hardened, then hard chrome-plated.

NOW!... You can save MORE with quality Miller "Job-Rated" Cylinders than with cut-price, lesser quality hydraulic cylinders. And the "Job-Rated" Cylinders are also available under the same immediate shipment program (2 hours if necessary—3 days normal) as the Power-Packed Line.

OTHER MILLER QUALITY FEATURES

- Rust-Resistant Surfaces
- Interchangeable, Space-Saving Square, 4-Tie-Rod Design
- Air Bleed In Cylinder Head
- Precision Honed Barrels

MILLER FLUID POWER

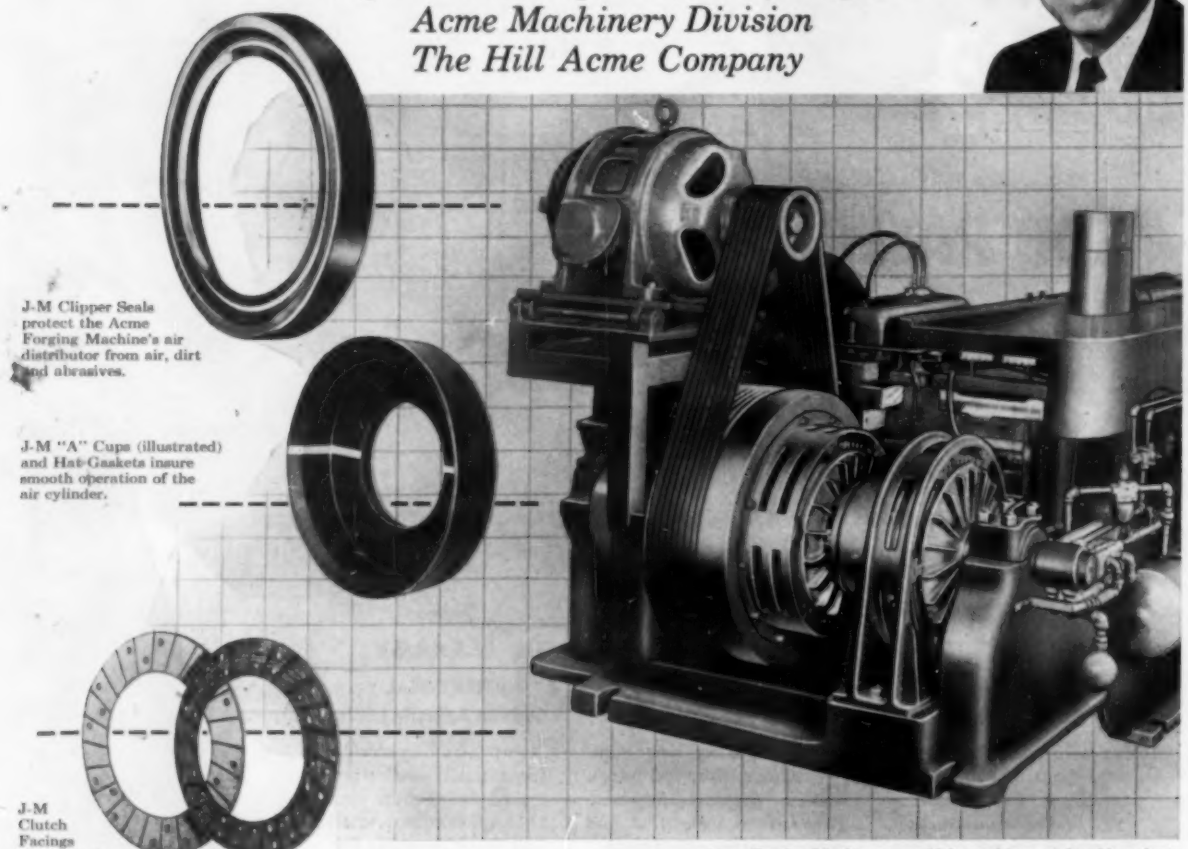
DIVISION OF TOLEDO-SCALE CORPORATION

2008 N. HAWTHORNE AVE., MELROSE PARK, ILL.

AIR AND HYDRAULIC CYLINDERS • ACCUMULATORS
COUNTERBALANCE CYLINDERS • BOOSTERS

"Customer satisfaction hit a new high when we redesigned Acme forging machines with J-M Packings and Friction Materials,"

says M. W. Lamprecht, Chief Engineer
Acme Machinery Division
The Hill Acme Company



J-M Clipper Seals protect the Acme Forging Machine's air distributor from air, dirt and abrasives.

J-M "A" Cups (illustrated) and Hat-Gaskets insure smooth operation of the air cylinder.

J-M Clutch Facings (illustrated) and Brake Linings play integral parts in the Acme Forging Machine's cushion drive mechanism.

Acme Forging Machines are widely used by metalworking plants all over the world. They are made by Hill Acme Co., pioneers and leaders in construction and design of modern forging machines.

J-M products defy extreme thermal and mechanical shock for dependable performance and long life

In terms of thermal and mechanical shock and the constant presence of dirt, chips and other abrasives, Acme Forging Machines provide one of the most rugged tests ever devised for packings and friction materials. In more than 20 years of service, Johns-Manville products have achieved an enviable record with Acme users. Performance has been more than satisfactory in every way and replacement has been held to the minimum.

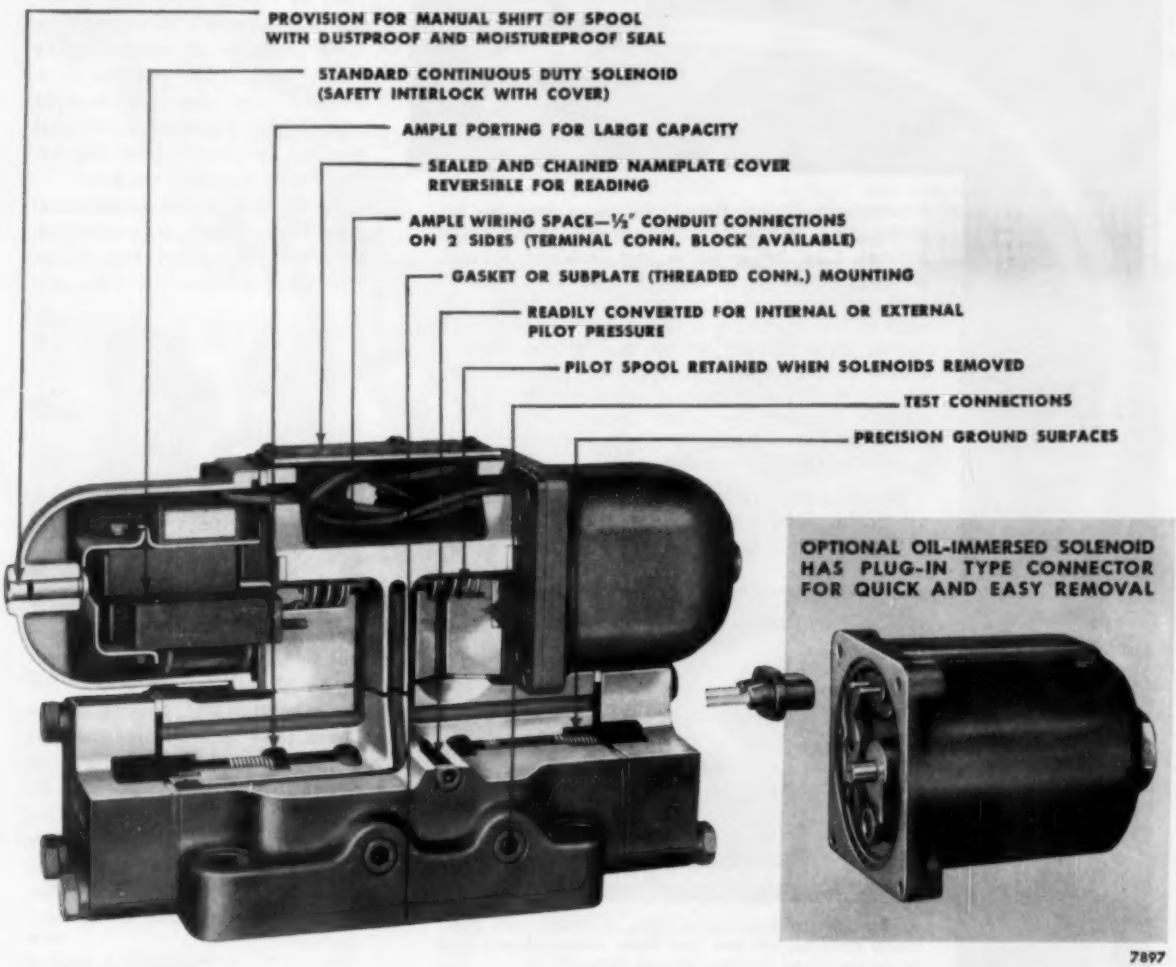
Johns-Manville makes a complete line of packings, gaskets, asbestos textiles, brake linings, clutch facings, transmission bands and industrial friction materials. Chances are one or more of these products may provide the answer to your design problems. For further information call your local J-M sales office or write Johns-Manville, Box 14, New York 16, N. Y. In Canada, Port Credit, Ontario.

JOHNS-MANVILLE

JOHNS-MANVILLE JM PRODUCTS

CIRCLE 55 ON PAGE 97

Only VICKERS® DIRECTIONAL VALVES Have *All* These Features


PROVISION FOR MANUAL SHIFT OF SPOOL WITH DUSTPROOF AND MOISTUREPROOF SEAL
STANDARD CONTINUOUS DUTY SOLENOID (SAFETY INTERLOCK WITH COVER)
AMPLE PORTING FOR LARGE CAPACITY
SEALED AND CHAINED NAMEPLATE COVER REVERSIBLE FOR READING
AMPLE WIRING SPACE—½" CONDUIT CONNECTIONS ON 2 SIDES (TERMINAL CONN. BLOCK AVAILABLE)
GASKET OR SUBPLATE (THREADED CONN.) MOUNTING
READILY CONVERTED FOR INTERNAL OR EXTERNAL PILOT PRESSURE
PILOT SPOOL RETAINED WHEN SOLENOIDS REMOVED
TEST CONNECTIONS
PRECISION GROUND SURFACES
OPTIONAL OIL-IMMERSED SOLENOID HAS PLUG-IN TYPE CONNECTOR FOR QUICK AND EASY REMOVAL

7897

REDUCED DOWN-TIME
LONGER SOLENOID LIFE
LESS MAINTENANCE
EASIER INSTALLATION

Vickers hydraulic 2- and 4-way valves provide the optimum in directional control. They are compact, versatile, and are designed for heavy duty, continuous and rapid cycling operation on all types of industrial machinery. More than a decade of application experience and years of research and development back all the valves' features.

Seven spool types satisfy a wide variety of circuit needs and operate at pressures to 3000 psi. Optional oil-immersed solenoids operate cooler, increasing service life 20 to 30 times.

Installation is simplified with ease of wiring and a minimum of piping. The valves are available for gasket or sub-plate mounting. Mounting position is unrestricted except in "no-spring" models. The optional oil-immersed solenoid has a plug-in type connector and is available in all standard voltages. Field modification of existing units can be made to incorporate heavy-duty, oil-immersed solenoids.

The valves conform to JIC Standards and are available in ⅛" and ¼" direct solenoid operated models . . . ¾", 1¼", 2", and 3" solenoid controlled pilot operated models. These valves cover the flow range from 1.25 gpm to 320 gpm.

For further information, write for Installation Drawing I-182412.

VICKERS INCORPORATED
DIVISION OF SPERRY RAND CORPORATION
Machinery Hydraulics Division
ADMINISTRATIVE and ENGINEERING CENTER
Department 1474 • Detroit 32, Michigan

Application Engineering Offices: ATLANTA • CHICAGO • CINCINNATI CLEVELAND • DETROIT • GRAND RAPIDS • HOUSTON • LOS ANGELES AREA (El Segundo) • MINNEAPOLIS • NEW YORK AREA (Springfield, N.J.) • PHILADELPHIA AREA (Media) • PITTSBURGH AREA (Mt. Lebanon) • PORTLAND, ORE. • ROCHESTER ROCKFORD • SAN FRANCISCO AREA (Berkeley) • SEATTLE • ST. LOUIS • TULSA WORCESTER

FACTORIES ALSO IN AUSTRALIA, ENGLAND AND GERMANY
IN CANADA: Vickers-Sperry of Canada, Ltd., Toronto and Montreal

CIRCLE 110 ON PAGE 97

NOW—a Flexible Plastic Tubing that Outperforms Metal

Chemiseal® Nylon Pressure Tubing requires no prebending, no flexible couplings and intermediate fittings. Can be installed and fastened around existing equipment. Utilizes standard metallic flare and compression fittings. Provides high pressure rating at low cost. Has exceptionally high resistance to flex and vibrational fatigue. Resists abrasion and impact. Is unaffected by oils, hydraulic fluids, alkalies and most solvents. Has service temperature range from —100° F to +225° F. Is odorless, tasteless, non-toxic, non-corrosive, fungus resistant.

Made in two grades, for 1000 psi and for 2500 psi which conform to J.I.C. specifications for low and medium pressures.

Use Chemiseal Nylon Pressure Tubing at a profit

. . . on pressure lubrication lines, hydraulic and pneumatic systems, oil and fuel lines, chemical and food processing lines, vacuum system connections, etc. You will find that its low cost, plus the fittings and labor it saves, make the installation only a fraction of the cost of metal tubing.

For prompt service, contact one of The Garlock Packing Company's 30 sales offices and warehouses throughout the U.S. and Canada, or write

United States Gasket Co., Camden 1, N. J.

® U.S.G. Trademark

United States Gasket *Plastics Division of* GARLOCK

BRIEFS

built by Snyder Tool & Engineering Co. of Detroit, Michigan. Five work fixtures are mounted on a rotary index table actuated by a hydraulic cylinder and shot-pin mechanisms. Pushbutton electrical controls are provided for this hydraulically operated machine.

In the first station, a universal joint flange which has a previously machined splined hole is accurately positioned for clamping

in the fixture by a spline plug detail that is inserted into the part by a hydraulic cylinder. Operation of a hand wheel control causes chuck jaws on a floating member to grip the part. The floating member is then locked in position by another hydraulic cylinder acting through wedges. Finally, the spline detail is raised from the part by the first hydraulic cylinder for indexing of the table to the next station. ▼▼▼

Continued on page 42

Four air-operated toggle clamps simultaneously compress a spring-loaded metal channel into the side of a window-sash frame for proper insertion of wood screws. Clamping and un-clamping is triggered by a valve lever. Detroit Stamping Co. designed the equipment.

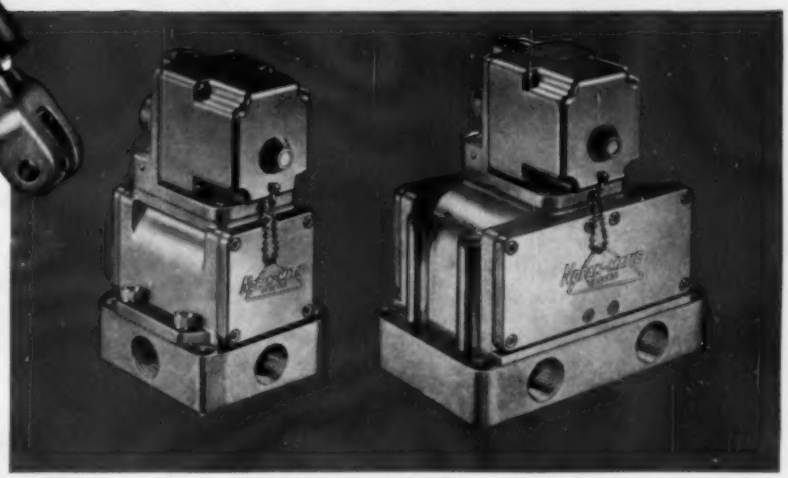
New NOPAK *Team*

delivers PLUS VALUES in Air Power!

NOPAK Air Cylinders, long known for their dependability and economy, now can be applied to even greater advantage with the new Nopak-matic pilot operated air control valves. Full flow design and dependable performance make NOPAK Cylinders and Nopak-matic control valves the perfect "team" for "in plant" or O.E.M. applications. They deliver Plus Values that you can measure in terms of greater speed, higher efficiency, easier maintenance, a wider range of adaptability and versatility.

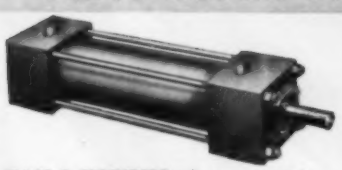
• NOPAK Class 1 and 2 Cylinders are available in 7 standard mountings in bore sizes from 1½" to 14" with a choice of non-cushioned, self-regulating or adjustable cushioned heads on all models.

• Nopak-matic, Pilot-operated, Poppet-type Air Control Valves are available in ¼", ⅜", ½" and ¾" pipe sizes for 2- or 3-Way normally open or normally closed operation, and 4-Way operation with master (air), single or double solenoid control heads. All 4-Way valves available, as standard, with choice of side or bottom ported sub-plates. Air pressures to 150 p.s.i.



Catalog 101-A and Catalog 105 provide complete descriptive and engineering data.

Other NOPAK Products for your Fluid Power Needs



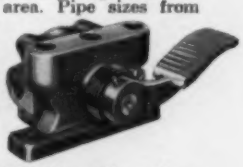
• **CLASS 3 CYLINDERS**—for pressures to 2000 p.s.i. Compact steel plate square head and tie-rod construction. Honed steel tubing. Heads may be cushioned or non-cushioned. Available in 14 standard mounting styles.

• **CLASS 4 CYLINDERS** — High Pressure Hydraulic — Heavy, honed steel tubing with lock-ring flange construction. For hydraulic (oil) service at line pressures to 3000 p.s.i. Choice of cushioned or non-cushioned heads. Available in 5 standard mounting styles.

• **CLASS M CYLINDERS** (Mill Type) Welded flange construction, with honed steel tubing, eliminates tie-rods. Recommended for all types of Heavy Duty air or hydraulic pressures up to 650 p.s.i. depending upon diameter.

The NOPAK line includes cylinders and valves for a wide range of fluid power application — and its precision control. In addition to standard air cylinders, there are heavy duty, mill-type cylinders, square head and lock-ring flange type hydraulic cylinders. The NOPAK Valve line includes the famous packless rotating disc valves in both hand and foot models, high pressure hydraulic valves, Flotrol speed control valves and reciprocating valves.

NOPAK 2- 3- AND 4-WAY HAND VALVES are used to control single or double-acting cylinders at air or hydraulic line pressures to 250 p.s.i. Precision lapped seal eliminates packing, prolongs valve life. Disc rotating at right angle to stream flow permits throttling action or immediate opening to full pipe area. Pipe sizes from ¼" to 2".



NOPAK 2- 3- AND 4-WAY FOOT VALVES incorporate all of the features of NOPAK hand operated disc-type valves including the lapped-disc design and packless construction. They are available in 3 types which are adaptable to a wide variety of control needs. Pipe sizes from ¼" to 1" for pressures to 125 p.s.i.

NOPAK FLOTROL SPEED CONTROL VALVES provide uniform control of cylinder speed in one direction, free flow in the other. Features: quick, easy, precision adjustment without tools; greater capacity; easy installation because of compact in-line design; fit in tight places; made of rust and corrosion proof materials. Pipe sizes from ¼" to 1".

Write for Catalog SW-3

NOPAK *VALVES and CYLINDERS*

GALLAND-HENNING NOPAK DIVISION • 2743 South 31st St. • Milwaukee 46, Wis.

A7-618-1P

CIRCLE 37 ON PAGE 97

ROCKRITE® TUBING—

"As Supplied"—
Ideal for cylinder applications

- costs less per finished pound—
- no processing of inside diameters—
- usable as supplied—
- overnight shipment from regional steel service centers—

ROCKRITE cylinder-finish, seamless tubing was developed expressly for cylinder application. Cold working by the ROCKRITE method imparts higher mechanical properties and exceptional machining qualities. Increased packing life will be obtained from ROCKRITE cylinder-finish tubing.

Stocked by leading steel service centers throughout the country. Immediately available in quantity in a complete range of standard sizes. Contact your leading tube distributor for one piece to a carload.

Write today for Bulletin R7A that describes ROCKRITE tubing.

ROCKRITE TUBING

TUBE REDUCING CORPORATION

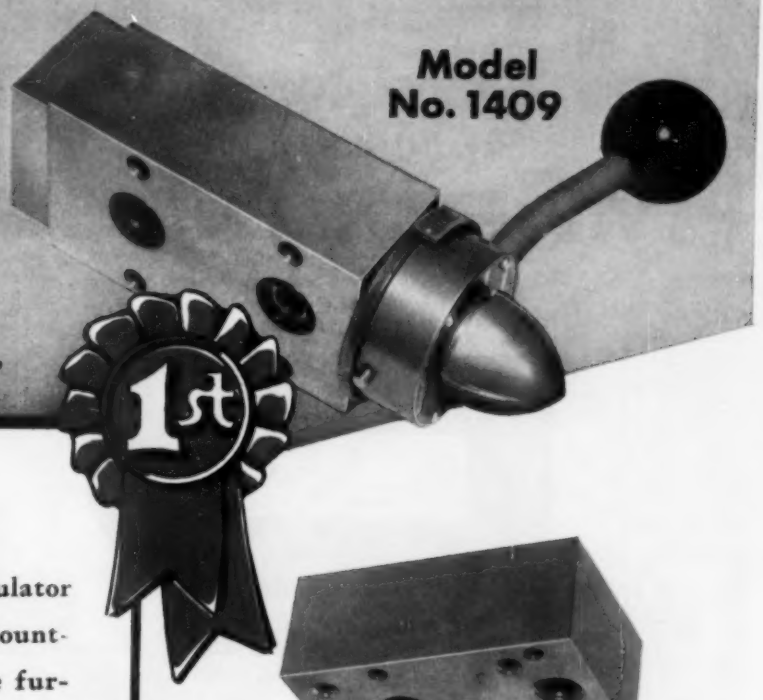
520 MAIN AVE., WALLINGTON, N. J.

Mailing address: P. O. Box 959A, Passaic, N. J.

Another WATERMAN WINNER

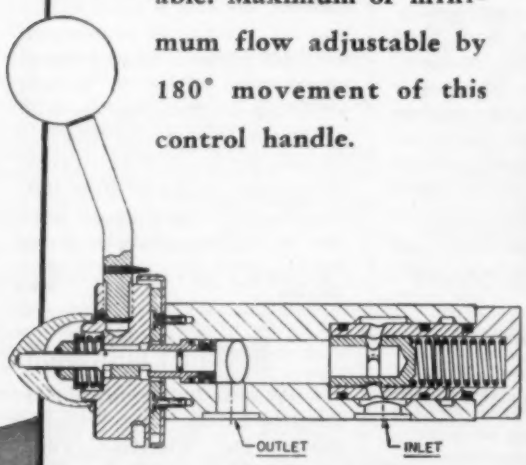
Model No. 1409

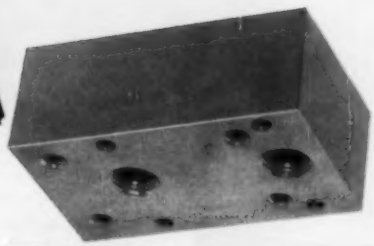
Adjustable Flow Regulator

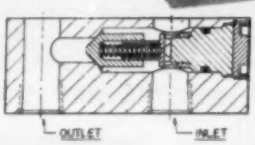


An adjustable flow regulator adapted for manifold mounting. Sub-plate kits are furnished with built-in check valves for free reverse flow. They are interchangeable, dependable, light-weight and easily installed.

Either right or left hand rotation of control handle is available. Maximum or minimum flow adjustable by 180° movement of this control handle.

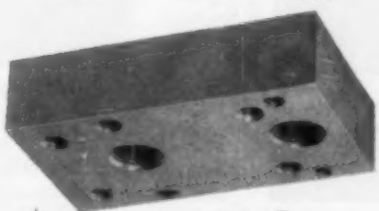


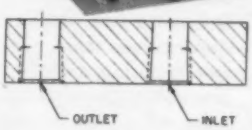




A

110534 Sub-Plate Kit with built-in check valve for free reverse flow.





B

110516 Sub-Plate Kit.

Write for illustrated bulletin A, describing the many valuable features of this Adjustable Flow Regulator.

WATERMAN ENGINEERING COMPANY

725 CUSTER AVENUE • EVANSTON, ILLINOIS

CIRCLE 115 ON PAGE 97

UCON

BRAND

HYDROLUBES

FLP

PROTECTION The fire-resistance of CARBIDE's fire-resistant hydraulic fluids has been proved by severe, exhaustive laboratory tests. And, in actual service, water-base UCON hydrolubes have prevented serious fires and injuries during more than 10 years of routine use in all types of industrial hydraulic equipment. The common fire hazards connected with hydraulic operations are eliminated when UCON hydrolubes are used. UCON hydrolubes are classified as acceptable, less hazardous fluids by Factory Mutual Laboratories.

ECONOMY UCON hydrolubes 150-CP and 275-CP are the economical answer to fire-resistance in hydraulic fluids. Most commercial hydraulic equipment can be easily converted to UCON hydrolubes with a minimum of time and expense. UCON hydrolubes have no harmful effects on most packings or seals. In fact, in many instances, reduced leakage losses have been reported. UCON hydrolubes also provide maximum protection against liquid and vapor phase corrosion and have outstanding anti-wear characteristics—thus, pump replacement costs are also held to a minimum.

Why not get all the facts on how UCON hydrolubes can mean protection plus economy for you. Write today for the booklet, "UCON Hydrolubes Spell Safety," F-40134.

UNION CARBIDE CHEMICALS COMPANY

Division of UNION CARBIDE Corporation

30 East 42nd Street, New York 17, N. Y.

"Ucon" is a registered trade-mark of UCC.

BRIEFS

Hydraulic Shot Hole Drill

Hand held coal drill powered by hydraulic motor has demonstrated these advantages over previously used electric motor drives: no explosion-proofing of motor and switches; lower maintenance costs; weight and size reduced 40 to 50%, and drilling speed and torque increased by the same percentage.

The drill uses a hydraulic motor with a built-in three way valve which passes oil back to tank when

the drill is not operating. Made by Schroeder Brothers Corp., McKees Rocks, Penn., unit is usually powered from the hydraulic system of the cutting machine by a three way valve on the machine. Since the source of power and the valving (including the relief valve, which serves as a safety clutch) are all mounted on the machine, the drill is much lighter than its electrical counterpart. Available power is taken in speed rather than torque to prevent wrenching the drill from the drillers hands. Flow requirements of the unit are from 10 to 20 GPM and pressure may vary from 1000 to 1750 PSI depending on hardness of drilling, available power supply, speed required and other factors. ▼▼▼

Recent Publications

Gray Iron Castings Handbook: prepared by Gray Iron Founders' Society Inc., Cleveland, Ohio; edited by Charles F. Walton, Technical Director. 607 pp.

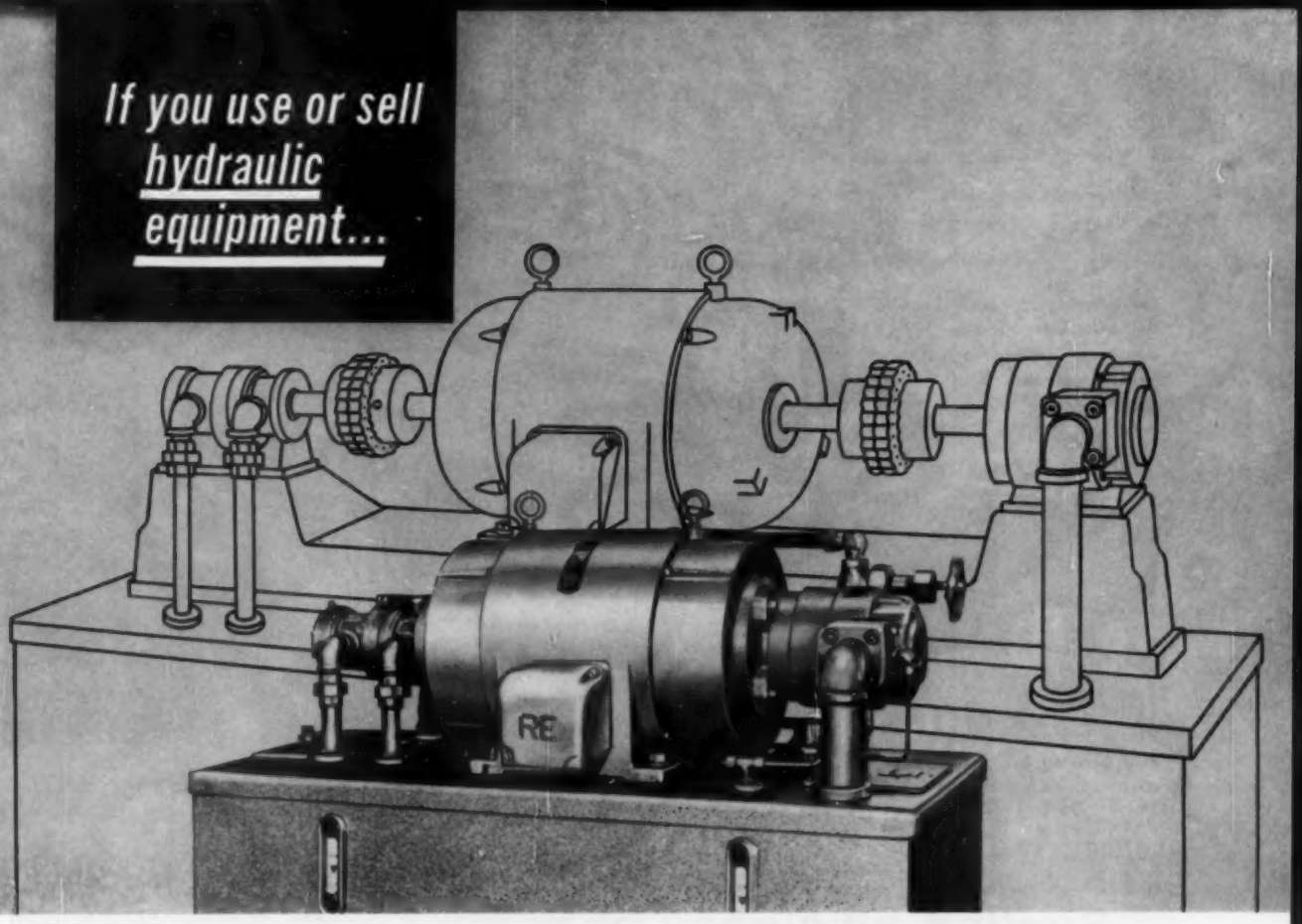
Engineering students as well as engineering, purchasing and man-

Continued on page 46

CIRCLE 184 ON PAGE 97

CIRCLE 82 →

If you use or sell hydraulic equipment...

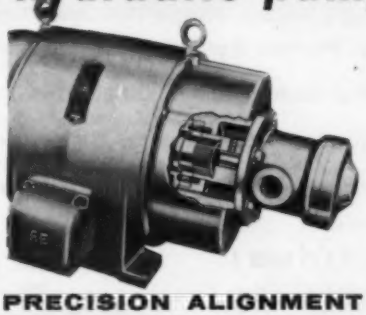


...cut space needs almost 50% with REULAND spline-coupled hydraulic pump mount motors!

Pump and motor become *one* with the new Reuland spline-coupled hydraulic pump hook-up. The pump shaft is connected directly to the motor's shaft *inside the motor.* Flexible couplings are eliminated... pump mount platforms are eliminated... and the tank length can be reduced because almost 50% less mounting area is required. Compact appearance is beautiful.

SPEEDY INSTALLATION

Pump-to-motor hook-up is merely a matter of seconds. All you do is slip the spline coupling onto the pump shaft...and attach the pump to the endbell. This spline coupling is supplied with the motor and is precision mated for each make of pump. There's no time wasted tinkering around... takes only a fraction of the ordinary time.



PRECISION ALIGNMENT

Alignment is perfect *automatically* whether the installation is made out in the field or on the production line. This permits even unskilled workmen to handle this simple task without error. Also, by hooking the pump up at the point of bearing support, within the motor, vibration is reduced to a new minimum. Operation is smooth, quiet.

COSTS LESS...SAVES INSTALLATION LABOR... FITS ALL PUMPS

The Reuland spline-coupled unit is priced lower than a conventional set-up... saves you extra money by reducing installation costs. What's more, we can supply it to fit any make of pump you may be using. So sure are we that it will be of help to you, we are offering to engineer a demonstration unit to *your* equipment, without the slightest obligation. These units are our best salesmen.

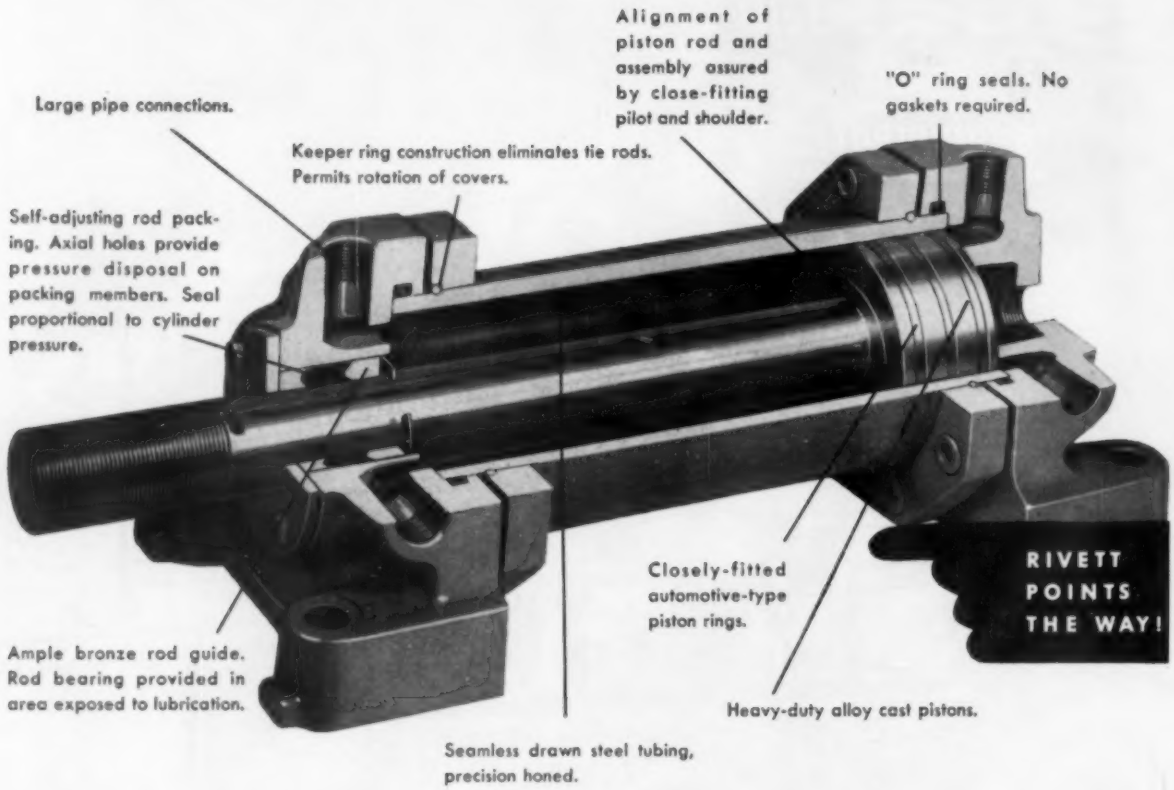
OUR NEW GENERAL CATALOG WILL COME IN HANDY—SENT FREE ON REQUEST.

MODERN POWER FOR MODERN-DAY PRODUCTS

REULAND MOTORS

REULAND ELECTRIC COMPANY
WESTERN DIVISION: Alhambra, California
EASTERN DIVISION: Howell, Michigan
DISTRIBUTORS IN ALL PRINCIPAL CITIES

*Trademark Registered


Large pipe connections.
Alignment of piston rod and assembly assured by close-fitting pilot and shoulder.
"O" ring seals. No gaskets required.
Keeper ring construction eliminates tie rods. Permits rotation of covers.
Self-adjusting rod packing. Axial holes provide pressure disposal on packing members. Seal proportional to cylinder pressure.
RIVETT POINTS THE WAY!
Closely-fitted automotive-type piston rings.
Ample bronze rod guide. Rod bearing provided in area exposed to lubrication.
Heavy-duty alloy cast pistons.
Seamless drawn steel tubing, precision honed.

Sealing efficiency improves with increased pressure in Rivett 1500 PSI* Cylinders!

*Higher on application.

- External "O" Rings Act As Static Seals To Eliminate Gaskets And Assure LEAKPROOF OPERATION!
- Automotive Type Piston Rings Reduce Friction, Increase Sealing Ability, Permit Sensitive Response To Any Pressure.
- Keeper Ring Construction Eliminates Tie Rods.
- Self-Adjusting Rod Packing Cuts Friction.
- Unfailing Power For Millions Of Cycles.

1080 SELECTIONS!

7 mountings; 10 bores; standard and 2:1 over-size rod; single and double end rods; internal or external thread; cushioning either or both ends; special covers.

RIVETT, INCORPORATED • Dept. AH-2
Brighton 35, Boston, Mass.

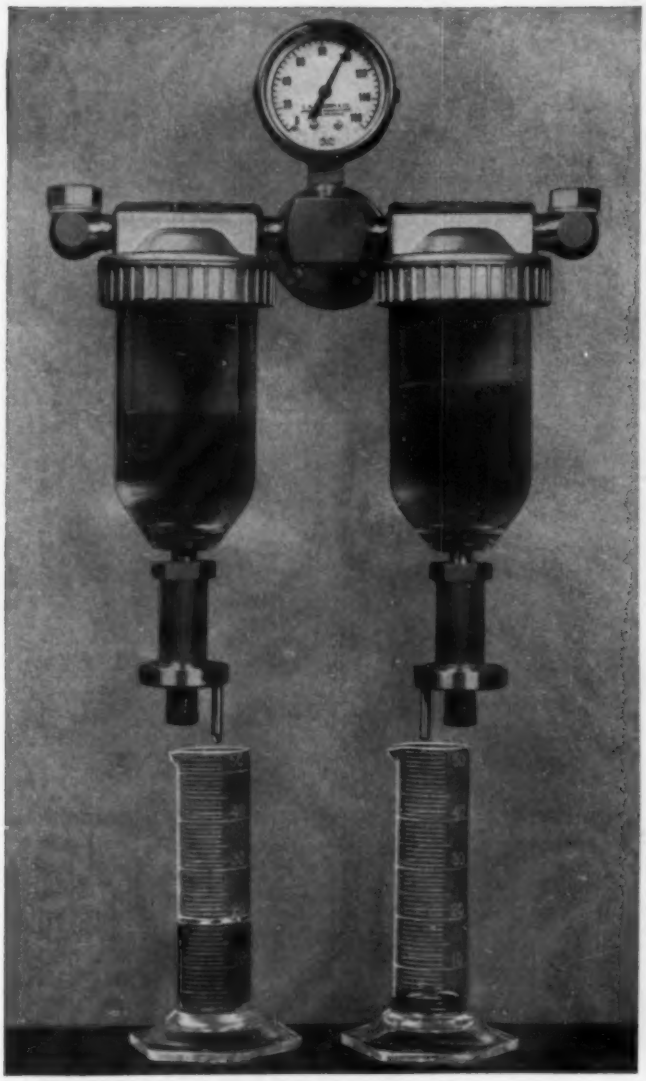
Get Catalog No. 106 to aid your circuit design. Complete drawings, specifications, cut-away views, tables, diagrams!

Member National Fluid Power Association

THE BETTER YOU KNOW HYDRAULICS THE BETTER YOU LIKE

RIVETT
"100"
HYDRAULIC CYLINDERS

CIRCLE 83 ON PAGE 97



SUNTAC CUTS HYDRAULIC OIL LOSS AS MUCH AS 75%

See this demonstration in your plant

Take about five minutes at your own desk to learn how Suntac® oils stay put in hydraulic systems . . . reduce oil loss through loose joints and worn fittings.

Match Suntac against the hydraulic oil you're now using—see how the exceptional non-gummy antileak characteristics of Suntac can reduce your oil losses as much as 75%. *Some users have even reported savings of 90%.*

ANTILEAK DEMONSTRATION

Suntac oil in one chamber, your present hydraulic oil of the same viscosity in the other. Both oils are forced out through sintered bronze bearings. In this photograph, pressure of 100 psi caused a straight mineral oil to leak out four times faster than Suntac.

Call Your Sun Representative

Have him arrange with a Sun Lubrication Engineer to give you and your staff a private demonstration. For further information on the uses of Suntac in hydraulic systems and in general lubrication, write to SUN OIL COMPANY, Philadelphia 3, Pa., Dept. AH-2.

SUNOCO

INDUSTRIAL PRODUCTS DEPARTMENT

SUN OIL COMPANY PHILADELPHIA 3, PA.

© SUN OIL CO., 1957

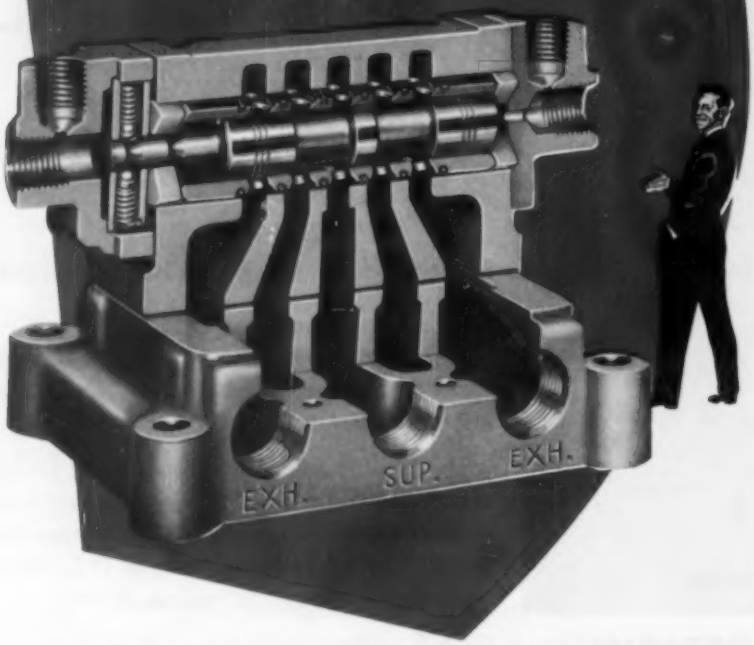
IN CANADA: SUN OIL COMPANY LIMITED, TORONTO AND MONTREAL

CIRCLE 96 ON PAGE 97

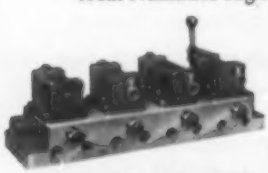
Specify **NUMATICS VALVES**
... there are no "equivalents"

VERSATILITY...

UNMATCHED IN PILOT OPERATED VALVES



Numatics leads the way again, with a brand new line of pilot operated, 4-way valves, using Numatics' famed lapped spool floating sleeve action . . . action that permits applications ordinary valves can't handle. For example, these valves take vacuum and pressures to 300 psi., with a pilot pressure, independent of main line pressure . . . minimum pilot pressure, in fact, is 10-15 psi. even at 300 psi. main line! Further, Numatics' new line offers nine different valving actions, four pipe sizes and mounting styles in *144 models* . . . every one a multi-purpose valve that can be used eight different ways! Want the whole story? Write today . . . or better, call your local Numatics engineer.



NUMATICS MANIFOLDS

For mounting Numatics pilot operated or solenoid valves . . . interchangeably, if desired. Offered in 4 pipe sizes, 2 to 6 valve stations.

numatics, Inc.

HIGHLAND, MICHIGAN Dept. AH

MINIATURE PILOT VALVES

Now, too, a complete new line of miniature pilot valves is available for application with Numatics pilot operated valves, Numatics manifolds.

BRIEFS

agement personnel of companies using iron castings should find this book very helpful. It was felt that though there was a wealth of data and information on the subject recorded, no concise single volume was previously available.

The opening chapters trace the growth of gray and ductile iron casting from the first crude examples produced more than 2000 years ago in Mesopotamia to the annual 14 million tons of today. Functional and economic advantages of the casting process are listed, and the special qualities of gray and ductile iron for castings are pointed up. Technical data on properties of the material, processing and alloying for special qualities, and on machining and finishing castings is included.

One of the book's nine chapters tells how to specify and purchase from foundries, explaining all the selection factors, and shows a suggested purchasing form. ▼▼▼

Continued on page 48

This five-station, open-gap horn press was designed by Hydraulic Press Mfg. Co. Div., Koehring Co., Mt. Gilead, Ohio, for punching and embossing operations formerly requiring several presses. The five main cylinder and ram assemblies are controlled individually by foot pedal. Each of the five main rams has a six-inch stroke and a pressure capacity of 100 tons, with tonnage range for each ram adjustable from 4 to 100 tons. Entire unit is powered by a 50 hp electric motor and a 100-gallon, radial-type, piston pump. ▼▼▼

CIRCLE 69 ON PAGE 97

New CFC Honan-Crane Hydraulic Filter Meets JIC Specifications

Now, in this compact K-Type Filter, you are assured of continuous micro-clarity of all hydraulic fluids — for abrasive contaminants only, or for both solid and dissolved impurities. It's easy and economical to keep hydraulic fluids clean — avoid downtime, prevent excessive wear, safeguard against clogged valves and pistons.

NEW FLO-PAC

Filters Out 98% of All Particles Over 5 Micron.

The new FLO-PAC 5 Cartridge is designed to remove 98% of all particles larger than 5 microns. Tough, resin-impregnated pleated paper provides more than 6300 square inches of filtering surface. Paper is inert — will not remove additives. FLO-PAC 5 is especially designed for high flow-rates; for either full-flow or by-pass filtration; and for water-base hydraulic fluids.

"T" TYPE CRANITE

for Solid Particles and Products of Oxidation

The new K-Type Cartridge was developed specifically to best meet JIC hydraulic standards. It contains 13 pounds of Type "T" Cranite (fuller's earth) enclosed in a metal container. It removes water, acids, tars, and asphaltines as well as solid contaminants. Processed at extremely high temperatures, Type "T" Cranite is especially resistant to water. Cranite is packed so solidly that it cannot settle, thereby preventing by-passing. This new K-Type Cartridge is interchangeable in many makes of filters which meet JIC Specifications.

For technical literature, write today to Department AH.

COMMERCIAL FILTERS CORPORATION
MELROSE 76, MASSACHUSETTS
PLANTS IN MELROSE, MASSACHUSETTS AND LEBANON, INDIANA

MICRO-CLARITY AT MINIMUM COST

Fulflo FILTERS — *with genuine Honeycomb Filter Tubes for controlled micro-clarity of industrial fluids.*

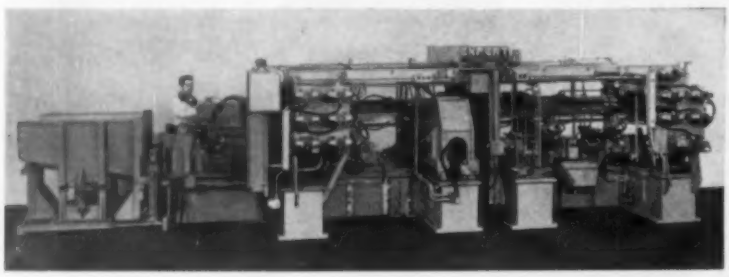
CFC FILTERS — *Selective filtration of oils • water-oil separators • magnetic separators • pre-coat filters • coolant clarifiers • automatic tubular conveyors.*

CIRCLE 25 ON PAGE 97

BRIEFS

Fluid Power Automates Welding Machine

A seven station in-line processing machine, through extensive use of air and hydraulic power, combines the operations of welding, assembly, and testing. It assembles, welds a flange to one end of a steel tube, performs three machining operations on the other end, and tests the finished product —an automotive steering column.



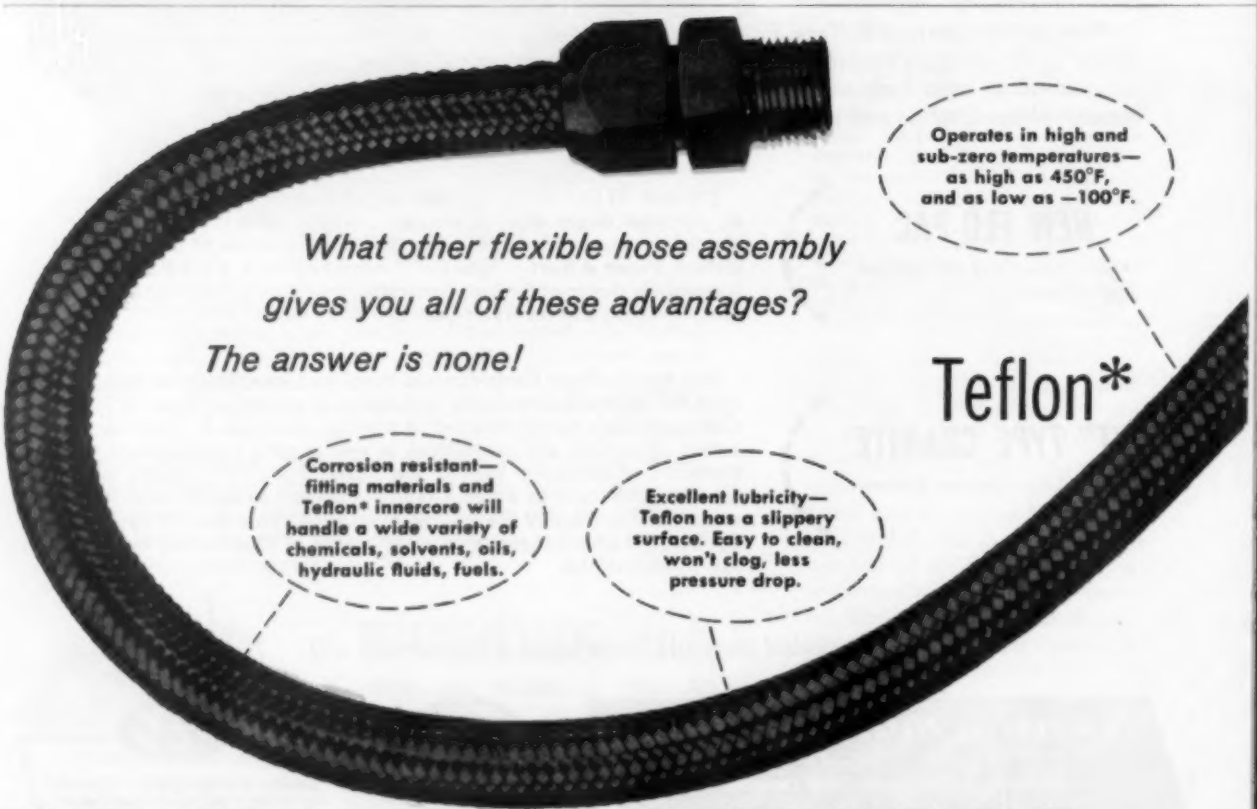
• **Operations**—An air powered lifter plate takes tubes from the loading hopper and transfers them to the feed magazine. They then slide, one at a time, to the shuttle plate; and then to the transfer bar mechanism which consists of seven clamping fingers, each operated by a hydraulic cylinder. The tubes are then moved from station to station by the hydraulically-operated, reciprocating transfer bar.

• **Stations**—In station one, the flange is oriented and assembled to the tube with a hydraulic press. The flange and tube are spot welded in the second station. The following five stations drill, slot, and ream the tube; test the assembly, and deposit it on a conveyor. Approximately 30 hydraulic hp is available for machine operations. The machine was developed by Expert Automation Machine Co., Detroit. ▼▼▼

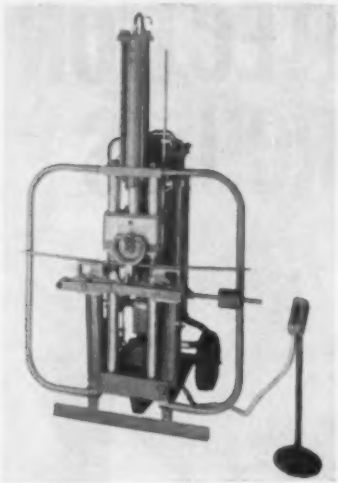
Hydraulic Bender Pushbutton Controlled

Vertical ram type portable bender built by Wallace Supplies Mfg. Co., Chicago, Ill., bends heavyweight steel up to 2-in. in bends up to 180 degrees, and needs only 100 x 45 in. floor space. The unit will form coils, return bends, special curves, angle irons, channels, reinforcing bars and flat bars. Setting of a duplicator stop allows an unlimited number of bend repititions.

The equipment includes a "jog" button for quick set-ups from field measurements or "lifted" bent-wire templates. A 7 gpm, 2000 psi gear pump is mounted on the oil reservoir and forms a part of the


Operates in high and sub-zero temperatures— as high as 450°F, and as low as —100°F.
What other flexible hose assembly gives you all of these advantages?
The answer is none!
Teflon*
Corrosion resistant— fitting materials and Teflon* innercore will handle a wide variety of chemicals, solvents, oils, hydraulic fluids, fuels.
Excellent lubricity— Teflon has a slippery surface. Easy to clean, won't clog, less pressure drop.
FROM END TO END . . . INSIDE AND OUT

machine's frame. The drive cylinder applies up to 38,000 lbs to the ram and the sliding head, which runs in vertical bar-type



ways. The head mounts the central bending die between two side dies carried by heads pivoted at the base of the bender for varying width or radius. The side dies rotate on studs on these arms as the bend is formed. ▼▼▼

BRIEF NOTES

KNOCKS OUT BACTERIA . . . E. F. Houghton Co. has a new version of their non-petroleum product used in water hydraulic systems—an additive retards bacterial growth. Starting with a reasonably clean water hydraulic system, the "bug-killer" will keep the system free of odor and filter clogging slime while it does its lubricating job.

BARCO MFG. CO. CELEBRATING FIFTIETH ANNIVERSARY, 1908-1958 . . . Barco Mfg. Co. will celebrate the 50th anniversary of its founding. Chiefly manufacturers of flexible pressure connections, Barco has grown from a small four man second-story factory in Chicago to its present 103,000 square feet of facilities in Barrington, Ill.

SILICONE RUBBER VULCANIZES AT ROOM TEMPERATURE . . . A wide range of applications is expected for General Electric's new series of silicone rubber compounds. Although requiring no special curing equipment or long curing times, the compounds offer many of the unique properties of regular silicone rubber.

ENGINEERING PROFESSION NEEDS CLASSIFICATION . . . according to William F. Ryan, president, American Society of Mechanical Engineers. A comprehensive, detailed survey of the profession has been undertaken by the Engineers Joint Council and Engineers Council for Professional Development.

DOUBLE A PRODUCTS JOINS BROWN & SHARPE . . . Double A Products Co. of Manchester, Michigan, has joined forces with the Brown & Sharpe Mfg. Co., Providence, R. I., as a wholly-owned subsidiary. Creation of new and broader hydraulic product lines by the combined organizations is planned.

Titeflex
Springfield
"140"
The Teflon innercore makes Springfield "140" hose assemblies extremely flexible. Long fatigue life.

Hose Assemblies with Reusable Fittings

Springfield "140" Teflon Hose Assemblies are approved for 1500 psi systems. Nominal hose diameter ¼" to ¾". Male pipe and J I C female swivel fittings available from stock.

In which of these applications can you use Titeflex Teflon?

- Acid handling
- Hot waxes and fats
- Liquid adhesives
- Silicone oils
- Chemical processing
- Food and beverage processing
- Steam lines
- Hydrogen peroxide
- Hot lacquers and enamels

Look in the yellow pages of your directory for the Titeflex distributor nearest you, or write direct for Titeflex Springfield "140" Catalog Supplement

TITEFLEX, INC., 601 HENDEE STREET, SPRINGFIELD, MASS.

Long life—Springfield "140" is unaffected by aging. Shelf life is practically unlimited.

*Teflon is a DuPont trademark for its tetrafluoroethylene resin.

. . . MADE RIGHT IN OUR OWN PLANT

PUROLATOR FILTERS FOR THE PROTECTION OF HYDRAULIC CIRCUITS

G-200M Aircraft Restrictor Filter two-way for hydraulic oil systems metal element

PR 301 ½ GPM line type hydraulic oil filter Micronic element

PR 362 3 CFM in-line vent type Micronic element

G 200 series in-line two-way restrictor filter Metal element, internal connections

PR 312 12 GPM line type filter Micronic element

PR 412-8 12 GPM line type filter Military approval

G-187 3 GPM in-line hydraulic oil filter Metal element

P 32-28 Low pressure, high flow hydraulic oil filter

Effective filtration is essential for optimum performance in hydraulic circuits. To keep a system clean and functioning properly, it is important that the filter be designed specifically to meet the requirements of the job.

Purolator's complete line of filters for hydraulic systems includes models for every set of operating conditions likely to be encountered. A few are shown here; there are many more standard models from which to choose. If your application requires a special filter, Purolator will design and build it. Let Purolator work on your toughest filtration problem.

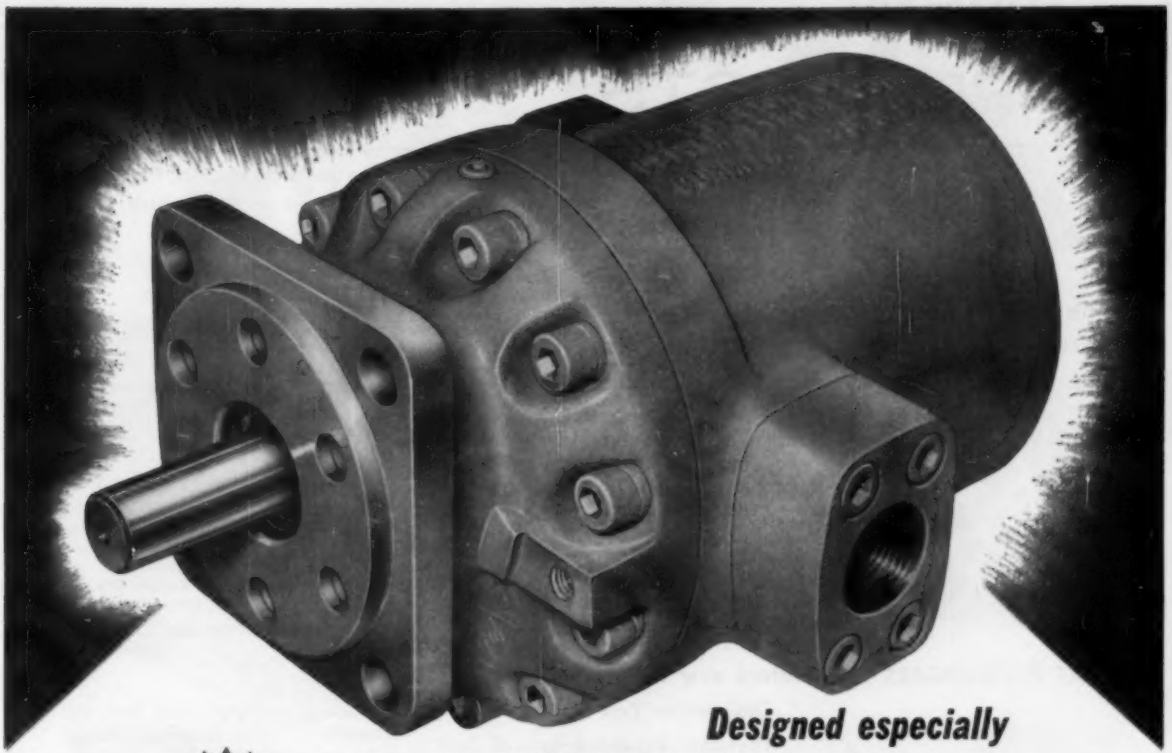
Filtration For Every Known Fluid

PUROLATOR

PRODUCTS, INC.

Rahway, New Jersey and Toronto, Ontario, Canada

CIRCLE 77 ON PAGE 97



Designed especially for 2000-3000 psi industrial service...

The NEW BERRY HYDRAULIC PUMP/MOTOR

Has these important features:

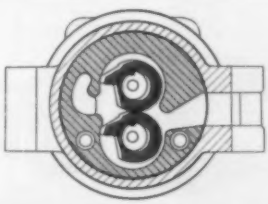
- ★ **Maximum torque at "stall"**
- ★ **Design proven in oil, gas, elevator and lumber industries**
- ★ **Competitively priced**
- ★ **Will carry overhung chain or belt loads**
- ★ **Flange or foot mounted**
- ★ **Instantly reversible**
- ★ **Smooth, constant torque at all speeds**

Write

for complete information and data on suitability for your application.

BERRY HYDRAULICS

A DIVISION OF OLIVER TYRONE CORPORATION
ROOM 2241 OLIVER BUILDING, PITTSBURGH 22, PA.



Schematic diagram above shows one of the two sets of pistons in the sturdy Berry Rotary Piston design.

CHARACTERISTICS
Models A-12 and A-12B

Drive Shaft Rotation	Reversible
Working Pressure	2000 psi
Surge Pressure	3000 psi

Operated as a Pump

Drive Shaft Speed—Maximum	1200 rpm
Displacement	12 gpm*

**Capacities from 7.5 to 12 gpm at rated speed are also available.*

Operated as a Motor

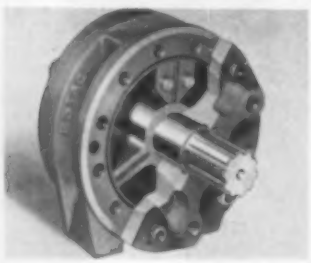
Drive Shaft Speed—Maximum	1800 rpm
Displacement—CIR	2.356
Displacement—GPR	.0102
Theoretical Torque inch lbs./100 psi	37.4

CIRCLE 16 ON PAGE 97

NEW PRODUCTS

Components, tools and equipment for fluid power systems. For more information fill in and mail post card bound in this issue.

ROTARY ACTUATORS . . . for oil, water & air



Designation: Rotac

Features: Reciprocating actuators consist of a cylindrical chamber containing a vane on a central shaft. The assembly is enclosed by cylinder end caps, through which the shaft projects. Pressure applied to either side of the vane causes the shaft to rotate; pressure reversals provide reciprocating movement. Movement is limited to a maximum arc of 280 degrees by a stop within the cylinder. Standard models develop 150 to 300,000 inch pounds of torque at 1000 psi input pressure. Torque can be doubled by utilizing two vanes instead of one, with the circular travel reduced to 100 degrees.

Ex-Cello-O Corp., Rotac Div.
Greenville, Ohio

CIRCLE 300 ON PAGE 97

HEAT EXCHANGERS . . . feature new refinements

Designation: Type BCF

Features: Expanded line of heat exchangers have better performance at lower cost. Units are offered in 46 sizes with from 1.2 to 124 square feet of heat transfer surface, in one, two and four pass designs. New baffle structure with flanged lip at each tube hose and around outer edge gives a tighter tube fit and better thermal characteristics. Stamped steel feet are movable in three positions around hubs for more adaptable mounting; hubs are relieved under connections for unrestricted flow. For cooling lube oil, jacket water, hydraulic and other fluids, as well as process heating applications.

Ross Heat Exchanger Div.
American-Standard
Buffalo, N. Y.

CIRCLE 301 ON PAGE 97

SPEED CONTROL VALVE . . . for compact, in-line mounting

Designation: Flo-Set 1000

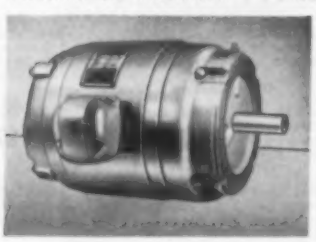
Features: Valve is designed to control the operating speeds of hydraulic cylinders and other hydraulically operated devices. The units allow a free flow in one direction and a controlled flow in the opposite direction. Flow can be controlled from zero to desired capacity with one revolution of the calibrated adjustment sleeve. The sleeve can be turned by hand or with the assistance of a wrench. Flow rate setting is locked in position by a set screw and locking collar. Established flow patterns can be reset by referring to the previous setting of the graduated sleeve.

Specifications: Maximum operating pressure is 1000 psi. ¼, ⅜, ½ and ¾ in. sizes.

Hanna Engineering Works
Chicago, Ill.

CIRCLE 302 ON PAGE 97

FOOTLESS MOTOR . . . has automatic alignment



Application: Designed for direct connection to driven equipment, motor is supplied with a NEMA style C unimount bracket for automatic alignment.

Features: Cast iron, one-piece frame is heat-treated to prevent warpage and is drip-proof. Windings are asbestos protected. A cast iron, split-type conduit box may be located above, below or on either side of the motor. Unit has ball bearings and solid cast and dynamically balanced rotors.

U. S. Electrical Motors Inc.
Los Angeles, Calif.

CIRCLE 304 ON PAGE 97

Continued on page 54

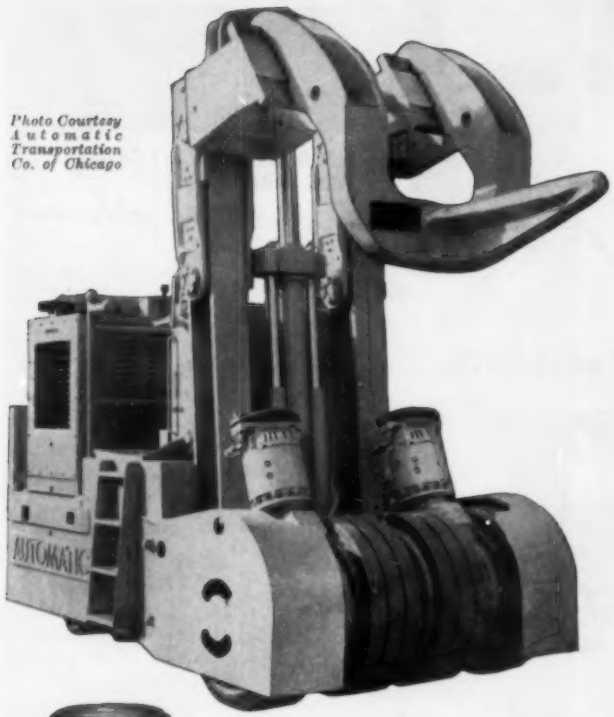


Photo Courtesy Automatic Transportation Co. of Chicago

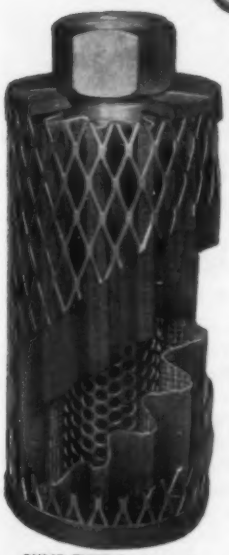
MARVEL SYNCLINAL FILTERS

are Standard Equipment on

GIANT SKYLIFT Model HR-250

by Automatic Transportation Co. of Chicago

Capable of lifting a 25,000 pound load. It is especially designed to haul coils in steel mills. Marvel Synclinal Filters are installed as standard equipment.

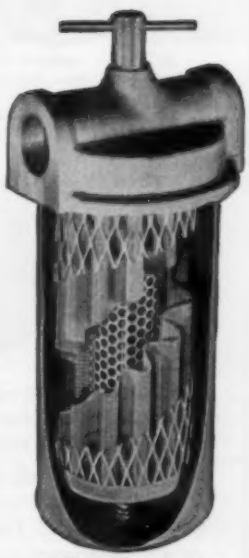


SUMP TYPE (cutaway)

OVER 800
Original Equipment Manufacturers

are installing Marvel Synclinal Filters for dependable protection on machinery, mobile or stationary, utilizing hydraulic and other low pressure circulating systems.

Marvel's BALANCED Synclinal Design
offers Greater ACTIVE Filtering area plus
Greater STORAGE CAPACITY for filtered out particles
RESULT—LOWER PRESSURE DROP
over prolonged periods of operation.



LINE TYPE (cutaway)

A SIZE FOR EVERY NEED

Available for sump or line installation in capacities from 5 to 100 G.P.M. Greater capacities may be attained by multiple installation (as described in catalog). Choice of monel mesh sizes range from coarse 30 to fine 200.

EASY TO CLEAN

Both sump and line types are easily disassembled, thoroughly cleaned and reassembled, on the spot, in a matter of minutes. Line type operates in any position and may be serviced without disturbing pipe connections.

IMMEDIATE DELIVERY

Catalogs contain dimensional charts and complete engineering data making it easy to order a filter for your specific requirements and get immediate Delivery.

For further information, write, wire, phone or use coupon below.

MEET J. I. C. STANDARDS

MARVEL ENGINEERING COMPANY
7227 N. HAMLIN AVE.,
CHICAGO 45, ILLINOIS
Phone: JUNIPER 8-6023

Without obligation, please send me complete data on Marvel Filters, as indicated: AH-2

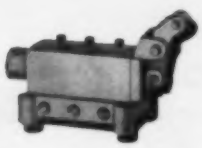
- ☐ Catalog #108—For Hydraulic Oils, Coolants, Lubricants
- ☐ Catalog #200—For Fire-resistant Hydraulic Fluids (Aqueous Base)
- ☐ Catalog #400—For Fire-resistant Hydraulic Fluids (Synthetic)
- ☐ Catalog #301—For Water

Name _____ Title _____
Company _____
Address _____
City _____ State _____

Get more production—at lower cost with

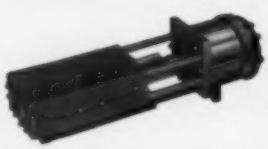
Quick-As-Wink®
AIR AND HYDRAULIC
Control Valves

½" Single Solenoid Two Position 4-way "B"-type Valve, for Pressures up to 250 psi.



¼" 4-way Cam Operated Spring Return Valve, for Pressures up to 125 psi.

½" 2 Pedal Foot Operated 4-way Valve, for Pressures up to 200 psi.



1" Pilot Cylinder Operated 4-way Two Position Hydraulic Valve, for Pressures up to 5000 psi.

Cut your costs—and increase your production—by installing Quick-As-Wink Control Valves **throughout your plant.** Proven in service, our exclusive, patented* construction assures year after year of long, efficient, dependable **and low cost operation.** Production and maintenance men know Quick-As-Wink Valves are unsurpassed. Can you afford to gamble with less? Hundreds of different types, actions and sizes from ¼" to 4". Get full details.

*U. S. Patent No. 2,645,430

Write for BULLETIN NO. 571 Today.

Quick-As-Wink®
AIR AND HYDRAULIC
Control Valves

Mfd. by C. B. HUNT & SON, INC., 1993 East Pershing St., Salem, Ohio

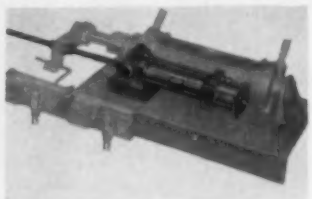
— Engineering and Sales Representatives in the Principal Cities —

NEW PRODUCTS

HYDRAULIC CHECKING CYLINDERS

. . . regulate air cylinders

Features: Units are designed for use with air cylinders to smooth out stroke variations under irregular loads. The cylinders provide a smooth, controlled stroke speed for tool or work piece feed on drilling,



milling, cut-off, grinding and similar machine operations. Maximum checking capacity is 2000 lbs. on the out stroke, with free return. Models are available with 2, 4, 6, 9, 12, 15 and 18 in. checking stroke lengths. Speed control is dial-set, and is load compensated to assure uniform feed under changing loads.

Modernair Corp.
San Leandro, Calif.

CIRCLE 305 ON PAGE 97

COMPRESSED AIR FILTERS

. . . have replaceable bowl

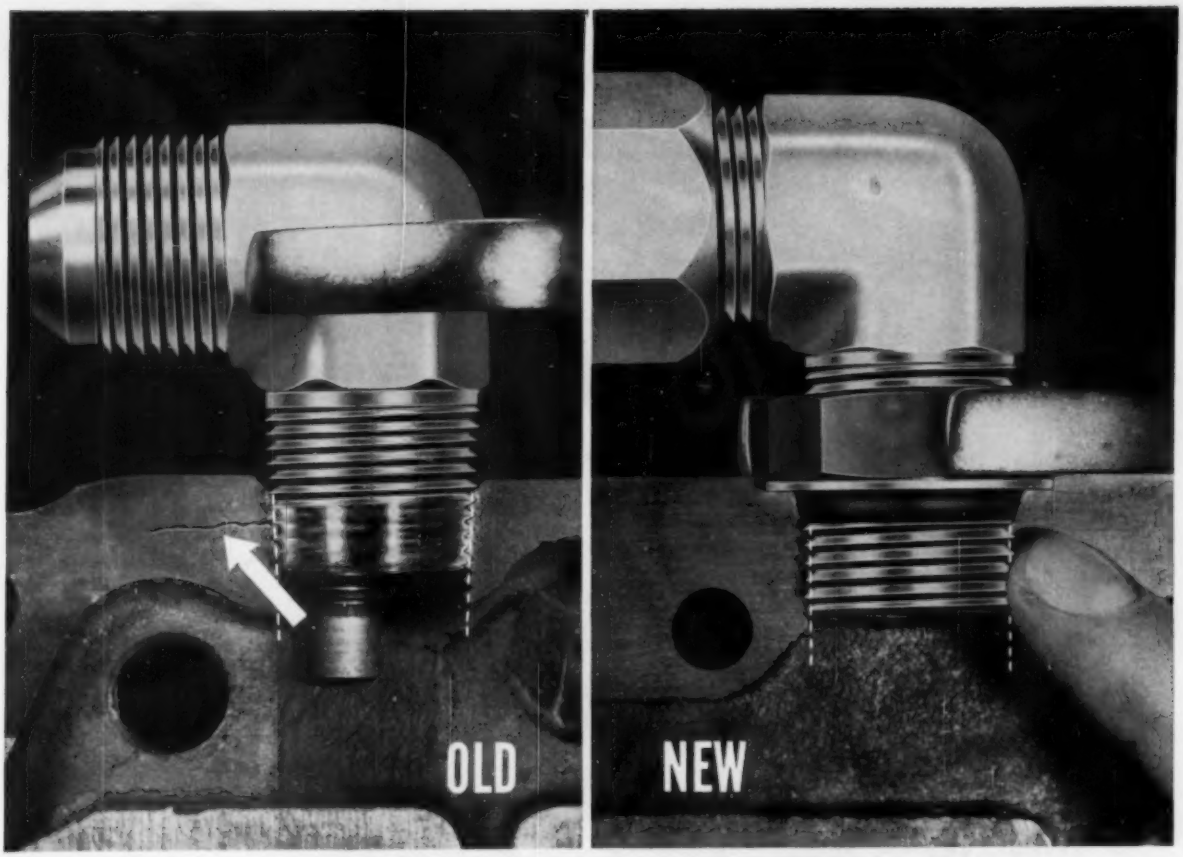
Features: Units are replaceable metal bowl type with automatic or manual draining. The automatic model has a float-controlled drain mechanism which discharges only when collected liquids reach full capacity. Both automatic and manual drain types include a new louver plate which improves centrifugal action and moisture removal and a quiet zone which prevents collected liquids from returning to the air line.

Specifications: Filters are designed for rough usage at pressures to 250 psi and temperatures to 200 F, on ¾ or 1 in. air lines. Choice of three interchangeable filter elements—74-, 64- and 25-microns—to remove abrasive solids.

C. A. Norgren Co.
Englewood, Colorado

CIRCLE 306 ON PAGE 97

For more NEW PRODUCT reviews turn to page 108



How Parker straight-thread fittings solve leakage problems

Forget about danger of cracking or distorting valve bodies by over-tightening the fittings. Forget about messy pipe "dope." Forget about leakage problems resulting from tapered pipe threads in high-pressure hydraulic systems.

Eliminate these problems. Use Parker O-ring seal straight-thread fittings (which conform with the SAE Standard for Hydraulic Tube Fittings) for leakproof, trouble-free connections. Available on Parker *Triple-lok* (the industrial standard flare tube fitting) and on Parker *Ferulok* (flareless fitting for heavy steel tubing).

Ask your Parker Distributor today, or mail the coupon for complete information about Parker straight-thread fittings.

PARKER FITTINGS AND HOSE DIVISION

Parker Hannifin
creative leader in fluid systems

New, Broader Line of *Hoze-lok* fittings for medium- and high-pressure hydraulic service. Longer performance, greater re-usability. No skiving of hose. Easier make-up saves time and money.

PARKER FITTINGS AND HOSE DIVISION
Section 436-B
Parker-Hannifin Corporation
17325 Euclid Ave.,
Cleveland 12, Ohio

Please send:
- ☐ *Triple-lok* Fitting Catalog 4310
- ☐ *Ferulok* Fitting Catalog 4320
- ☐ *No-Skive Hoze-lok* Catalogs 4433 & 4434

Name_____ Title_____
Company_____
Address_____
City_____ State_____

CIRCLE 71 ON PAGE 57

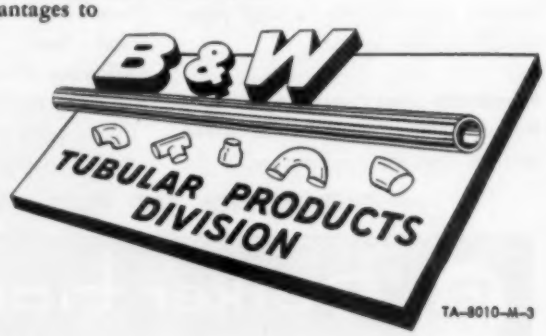
"B&W Tubing

assures easy fabrication–top quality operation for our hydraulic cylinders

As a hydraulic engineer, I'm interested in getting components that cut my fabrication work to a minimum without loss of end-use quality. That's why I always specify B&W Seamless Mechanical Tubing. It's *consistently* of the highest quality . . . and needs very little reworking."

This particular case history, documented in B&W's files, is only one example of the many successful applications of B&W Mechanical Tubing. Because of the high-precision standards to which it is produced, B&W Mechanical Tubing is received from the mill in a condition that often represents 90% of the unit for which it is intended. Advantages to engineers and craftsmen include high strength-to-weight ratio, as well as ability to assume almost any design shape without loss of structural advantages, material, weight and space savings.

B&W Mechanical Tubing is produced to order, to special sizes, shapes, finishes and analyses and to the mechanical properties needed in the end-use application. Ask for Mr. Tubes, the B&W specialist—he can help you simplify tube fabrication problems—or write for Bulletin TB-361. The Babcock & Wilcox Company, Tubular Products Division, Beaver Falls, Pa.



TA-8010-M-3

Seamless and welded tubular products, solid extrusions, seamless welding fittings and forged steel flanges—in carbon, alloy and stainless steels and special metals.

CIRCLE 11 ON PAGE 97

specify VICKERS - WATERBURY hydraulic pumps, motors, transmissions for MISSILE handling, launching and tracking systems...

when you require

1 extremely fast acceleration and reversal

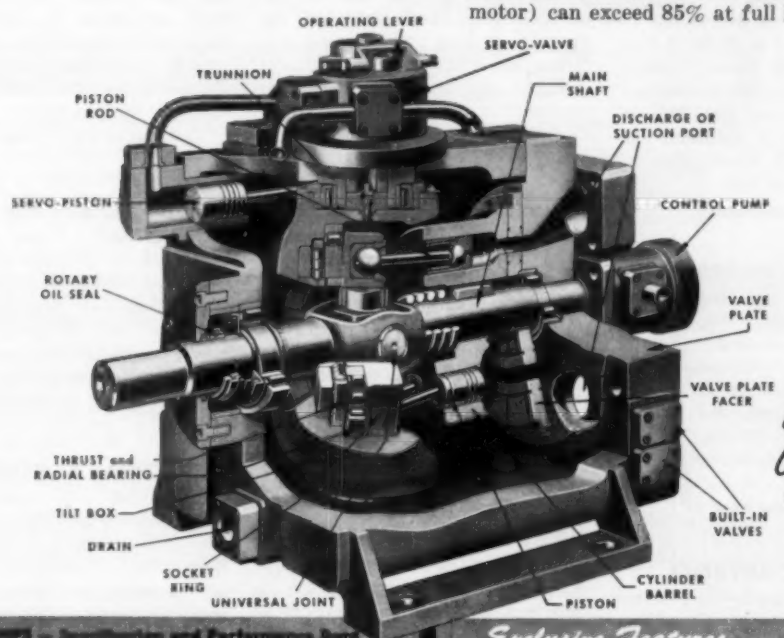
2 precise speed control.....

These axial-piston pumps and motors are particularly suitable for marine and ordnance drives where precise control of torque, acceleration and deceleration, speed or reversal are important.

The pump is a factory-assembled power package with built-in auxiliary pump (provides super charging, control pressure and forced circulation for cooling), replenishing and relief valves.

Transmissions are usually combinations of variable delivery pumps with axial-piston fixed displacement fluid motors. Peak output is at 3,000 psi from 45 to 3,600 hp.

Overall mechanical efficiency of these hydraulic pumps or motors exceeds 91% at full load; volumetric efficiency is 97% at 3,000 psi; torque efficiency, when used as a hydraulic motor, exceeds 95% at rated pressure; overall mechanical efficiency of a hydraulic transmission (pump and motor) can exceed 85% at full load.



Write for a Copy of Catalog 200

HEAVY DUTY PUMPS — Specifications and Performance Data

Heavy Duty Size	Rated Speed	Theoretical Maximum Displacement	Discharge in Gallons per Minute at Rated Speed* (Supercharged)			Horsepower Input*			Approx. Weight
	rpm	cu. in./rev.	1000 psi	2000 psi	3000 psi	1000 psi	2000 psi	3000 psi	lbs.
1½A HD	1200	5.65	29.1	28.9	28.4	20	38	56	350
2½A HD	1200	11.3	58.4	57.8	56.9	40	76	112	450
5A HD	1200	22.8	117	116	114	79	152	224	620
10A HD	900	45.2	175	173	170	119	227	334	1100
15A HD	720	67.8	210	208	205	142	273	403	1600
20A HD	600	90.4	233	231	227	158	302	446	2000
25A HD	600	158.2	408	404	398	277	529	782	4900
30A HD	514	226	500	495	487	340	648	957	6000
75A HD	514	338	750	743	731	508	974	1437	9000
150A HD	450	678	1514	1501	1481	881	1706	2519	27000
300A HD	400	1356	2338	2313	2277	1585	3031	4478	43000

*3,000 psi tabulation is an intermittent rather than continuous duty rating, and is recommended only where the specific application and duty cycle have the approval of our engineering department.

Exclusive Features...

1. Largest capacity (up to 2,300 gpm) and highest horsepower (up to 4,000 hp) in the oil-hydraulic industry.
2. Fastest stroking . . . in less than .03 seconds, the Size 5 Heavy Duty Pump can go from zero to full delivery.
3. Ultrafine control . . . training and elevating of large gun turrets, missile launchers, etc., have been handled by axial-piston transmissions with exceptional accuracy at speeds controlled to 1 rpm.
4. Most compact unit for large capacity equipment . . . a 2,300-gpm pump occupies only a six-foot cube.
5. Extreme ruggedness and reliability with exceptionally long life . . . many axial-piston units have been in operation for 20 to 25 years, some without overhaul.
6. Very rapid acceleration and deceleration and reversals with remarkable smoothness.
7. Controls, valving and auxiliary pumps can be incorporated directly in, or on, the units.

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Marine and Ordnance Department
WATERBURY 21, CONNECTICUT

Hydraulic Products for Marine and Ground Defense Applications

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CIRCLE 111 ON PAGE 97

USEFUL LITERATURE

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AIR & OIL CYLINDERS . . . for up to 250 psi air or 500 psi oil or water come in single and double-acting models, with bores up to 4½ in. and strokes to 20 in. A brochure published by *Alkon Products Corp., Hawthorne, New Jersey,* gives illustrations and specifications charts on "Model D" cylinders and "Model E", which have elliptical non-rotating piston rods.

CIRCLE 400 ON PAGE 97

FILTERS & STRAINERS . . . for fluids and gases are available in edge-type, cartridge-type, porous metal and screen-mesh designs. Specifications, performance, characteristics and application data, along with diagrams, charts and illustrations are all in catalog 58-100, issued by *Cuno Engineering Corp., Meriden, Conn.*

CIRCLE 401 ON PAGE 97

ELECTRICAL CONTROLS . . . are shown in a check list released by *Hart Manufacturing Co.,* Hartford, Conn., for engineers and purchasing agents. Includes capsule information about the company's line of "Diamond H" relays, thermostats, rotary switches, range switches motor controls and "snap-ins".

CIRCLE 402 ON PAGE 97

OIL SEALS, O-RINGS & PACKINGS . . . *International Packings Corp., Bristol, N. H.,* has published a very comprehensive manual which explains many types of seals. The booklet lists the factors considered in selecting the type of seal to be used, the sealing material—leather, rubber or synthetics—and coated or impregnated versions. Tables and drawings show dimensions of the packings, application methods, and recommended shape and finish of the packing recesses and wearing surfaces. The manual includes a glossary and conversion tables section.

CIRCLE 403 ON PAGE 97

AIR PUMPS . . . *Leiman Bros., Inc., Newark, N. J.,* has released a 24 page book containing blueprints of actual installations of the company's rotary air pumps. The units are for both vacuum and pressure operations, including lifting, blowing, suction, extraction, testing, materials transfer, drying, filling, chucking, feeding and packaging.

CIRCLE 404 ON PAGE 97

PRESSURE REDUCING VALVES . . . of sliding gate design provide pressure reduction up to 125 psig and dead end shut-off in all fluid services. 6-page Bulletin J-160, issued by *Jordan Industrial Sales Div. of OPW Corp.,* Cincinnati, gives complete information, including valve features, design improvements and method of operation. Contains flow capacity charts, dimensional drawings, control ranges and material specifications.

CIRCLE 405 ON PAGE 97

HOSE & REUSABLE FITTINGS for industrial use are adapted from equipment approved for aircraft hydraulic and fuel systems at pressures to 3000 psi and temperatures from —100 to 450F. Fittings are simple to install or remove; the hose is braided-wire with a Teflon innercore. Catalog supplement issued by *Titeflex, Inc., Springfield, Mass.,* illustrates the assembly and disassembly procedure, and gives design specifications, suggested applications and information for ordering the assemblies.

CIRCLE 406 ON PAGE 97

FULL-FLOATING SHAFT COUPLINGS . . . are shown and explained in Bulletin 98, released by *Thomas Flexible Coupling Co., Warren, Pa.* The couplings are used to connect widely spaced shafts on rotating machinery, and feature simplicity and long life.

CIRCLE 407 ON PAGE 97

INDUSTRIAL SOLENOIDS . . . are described in a condensed catalog released by *Detroit Coil Co., Ferndale, Michigan.* Bulletin gives illustrations, dimensional drawings and performance characteristics on every industrial solenoid model in the company's line, AC or DC, including multi-life, oil immersed models.

CIRCLE 408 ON PAGE 97

AIR CLEANERS . . . which operate without moving parts, filters or baffles are shown and explained in Bulletin 502, released by *V. D. Anderson Co., Cleveland, Ohio.* Units are installed like a pipe fitting on compressed air pipelines. Selection tables show the recommended size cleaners to install at various air and gas flows—specifications, prices and piping hookups are included.

CIRCLE 409 ON PAGE 97

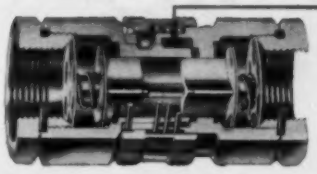
For more reviews of FREE LITERATURE turn to page 118

WHICH SNAP-TITE QUICK-CONNECT COUPLING IS BEST FOR YOU?

SNAP-TITE "H" COUPLING . . . . . FOR HIGH PRESSURE APPLICATIONS

FOR HYDRAULIC OR AIR

"H" Coupling for high strength, higher efficiency, high-resistance to heavy line surge. Sizes: ⅛" thru 12". Bulletin No. 240

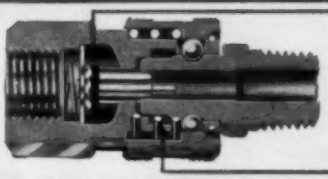


Exclusive U-packer gives a positive seal without compression set because of rubber distortion. Line pressure inside the U-packer keeps it open and forced against its metal backing—the higher the pressure, the tighter the seal.

SNAP-TITE HI-FLOW COUPLING . . . FOR LOW PRESSURE APPLICATIONS

FOR AIR AND FLUIDS UP TO 150 p.s.i.

Hi-Flow is recommended to connect small air tools to plant air system, and for low pressure fluid transfer in small lines. Sizes: ⅛" thru ¾". Bulletin No. 230

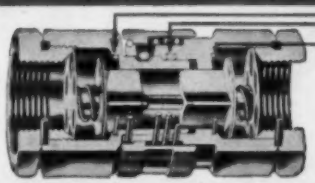


Bonded valve washer
(pat. pending on valve construction)

Exclusive U-packer

SNAP-TITE "HK" COUPLING . . . . FOR HARD TO HANDLE FLUIDS

FOR FUMING ACIDS, ALKALIES, SOLVENTS, AND HIGH PRESSURE STEAM . . . "HK" is the only coupling now on the market for fluid temperatures from —100° F to +500° F . . . and for live steam up to 460° F. Its seals are made of Teflon for which there is no known solvent. Sizes: ½" thru 3". Bulletin No. 270



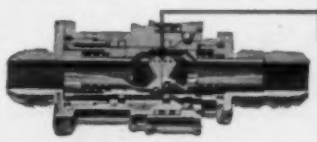
Teflon Valve Seal

Teflon Nipple Seal

Teflon Valve Seal

SNAP-TITE NO-SPILL COUPLING . . . FOR MINIMUM AIR INCLUSION

FOR AIRCRAFT, MISSILE HYDRAULIC, FUEL SYSTEMS which cannot stand air in the lines, and for transmitting fluids which *must not spill*, the Snap-Tite no-spill coupling is recommended. Bulletin No. 280

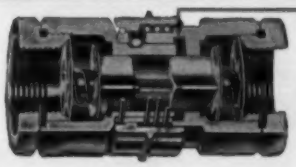


Flush valves prevent spillage, air inclusion. Snap-Tite will engineer special variations to your requirements.

SNAP-TITE "E" COUPLING . . . . . FOR VACUUM and VERY LOW PRESSURE

FOR VACUUM SYSTEMS IN THE MICRON RANGE

"E" Coupling performs in the *micron* range in the smaller sizes both connected and disconnected. Recommended, too, for gravity flow . . . U.L. approved for LP Gas. Sizes: ⅛" thru 12". Bulletin No. 250



Nipple seals in coupler by depressing the lip of the E packer and slightly compressing the body of the packer. This new E-packer gives positive seal under high-pressure, low-pressure, and vacuum.

Snap-Tite Couplings are available plain, (without valves), and with either single or double shut-off. Couplings normally furnished in alloy steel, but all (except hi-flow) are also available in brass, aluminum, or stainless steel with a variety of finishes.

SNAP-TITE, INC., UNION CITY 1, PA.

Snap-Tite

SNAP-TITE COUPLINGS CAN HANDLE ALMOST ANYTHING THAT FLOWS

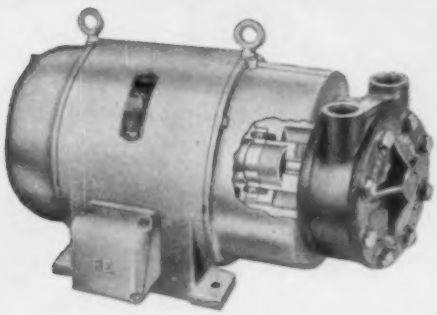
CIRCLE 92 ON PAGE 97

CIRCLE 56 ON PAGE 97

1

2

3 NEW TUTHILL close coupled pump and motor units



3

Save space, Save weight, Cut costs

Now TUTHILL offers three pump and motor combinations developed specifically for applications where space or weight are at a premium. Furnished in a wide variety of sizes and styles, one of these combinations can provide savings in hydraulic, oil burning, lubrication or other services.

The small size of these combinations solves design problems. By reducing weight they cut shipping charges. The elimination of couplings, adapters and bases means lower costs. And even more important savings are often made through the simplification of installation procedures.

Available from Stock

A wide variety of combinations are available immediately from stock, in either large or small quantities.

For example, Number 1 above is TUTHILL'S famous POWERMITE—a combination in which pump and motor are incorporated in one unit which takes up no more space than a standard electric motor (the POWERMITE shown measures only 3⅞" x 7½").

Originally restricted to large quantity applications some POWERMITE models are now available from stock for small quantity orders. The unit shown is rated for 16 GPH at 350 PSI.

For other small quantity applications TUTHILL provides a complete selection of close coupled units with the pump mounted directly on the motor. Numbers 2 and 3 above are typical.

For applications, such as hydraulics which require smaller pumps, units such as Number 2 above provide outstanding advantages. Normally they can reduce space required for pump and motor by at least 6 inches, and cut weight by several pounds. Capacities range from 20 to 300 GPH. Pumps are available for pressures up to 1500 PSI.

Larger pump and motor combinations, such as Number 3 above, can be provided with capacities up to 50 GPM, for pressures up to 400 PSI.

If you are trying to put a pump and motor into a small space, TUTHILL has the answer. Write for details.

Tuthill Manufactures a Complete Line of Positive Displacement Rotary Pumps in Capacities From 1 to 200 GPM; for Pressures to 1500 PSI; Speeds to 3600 RPM.

TUTHILL PUMP COMPANY

939 East 95th Street, Chicago 19, Illinois

Canadian Affiliate:
Ingersoll Machine & Tool Co., Ltd.
Ingersoll, Ontario, Canada

PUMPS FOR YOUR PURPOSE

TUTHILL PUMP COMPANY
939 East 95th Street, Chicago 19, Illinois

☐ Please forward complete information on TUTHILL close-coupled Pump and Motor Units for_____GPH at_____PSI.

☐ Please have your representative call.

NAME_____ TITLE_____

COMPANY_____

STREET_____

CITY_____

STATE_____

CIRCLE 103 ON PAGE 97

Brillo's presses use Texaco Regal Oil R&O 100%.

"No more gummed-up hydraulic systems"...

says Brillo Engineer Mario Saieva

"It took Texaco Regal Oil R&O to put our Brillo Soap Pad machines on a full-time production basis."

Brillo's padding machines, using Brand X hydraulic fluid, formerly became so gummed up that they frequently had to be stopped, cleaned—and sometimes entirely dismantled. Then, about five years ago, the Brillo Manufacturing Company switched to Texaco Regal Oil R&O. In the words of Engineer Saieva: "The steady and faultless performance of our hydraulic systems has saved us a lot of time, money and headaches. Texaco Regal Oil R&O cleaned up Brillo's hydraulic systems and has kept them free of gum, rust and sludge—has cut downtime 90%. Ditto with repairs."

The only possible piece of information that Texaco can add to a recommendation like that is . . . call the nearest of the more than 2,000 Texaco Distributing Plants in the 48 States, or write The Texas Company, 135 East 42nd Street, New York 17, N. Y.

TUNE IN... Metropolitan Opera Radio Broadcasts Every Saturday Afternoon

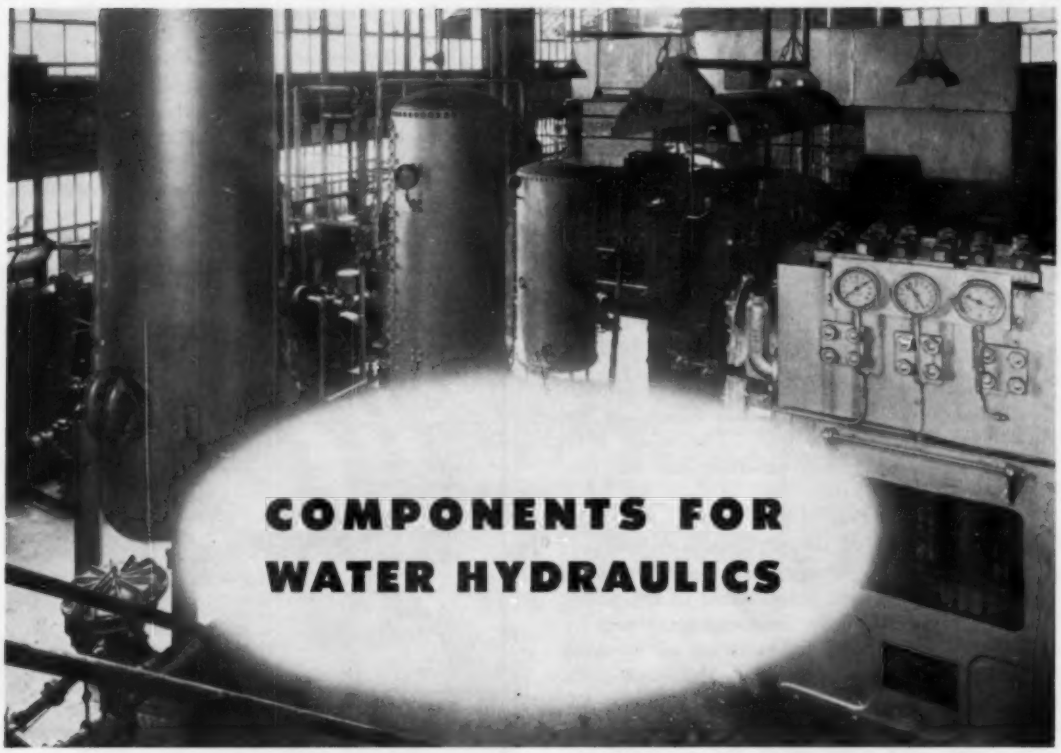
LUBRICATION IS A MAJOR FACTOR IN COST CONTROL

(PARTS, INVENTORY, PRODUCTION, DOWNTIME, MAINTENANCE)

CIRCLE 98 ON PAGE 97

SPECIAL REPORT

• By Allan E. Morris *Executive Editor,* APPLIED HYDRAULICS



COMPONENTS FOR WATER HYDRAULICS

It's rare nowadays to find a factory with overhead rotating shafts and belt drives to each machine. That type of centralized mechanical system has given way to individual drives which are a part of each machine. However this evolution has not been so complete in the hydraulics field where the central hydraulic system is still best for certain jobs.

In planning a new plant or expanding an old one engineers must sometimes make a major decision in selecting either a central system or individual pump units. Both have advantages and disadvantages. A central system is economical for jobs such as die casting and rubber and plastic molding where each press in a battery is doing the same operation. Savings are both in the initial cost and in operation. Cost of the few reciprocating and centrifugal pumps of the central system must be compared with cost of rotary pumps for each machine. Accumulators, pressure recorders, and air compressors of the central system must be compared with electric motors, individual pump controls for high and low pressure, and separate tanks of the integral systems.

Most central systems use water as a fluid and this gives bonus advantages of fire resistance and low cost. Fire resistance is especially important in die casting, forging, extruding. Frequently machines, for these jobs require large amounts of fluid, so that low cost water with 3-5% soluble oil is ideal. At the same time, leakage becomes less of a problem, especially when you consider the price of fire resistant fluids.

Components for oil hydraulics are frequently not suited to water because of its lower viscosity and poorer lubrication. Reciprocating plunger pumps operating at relatively low speed replace the gear, vane and piston pumps common to oil hydraulics. Tight sealing poppet valves replace spool types because of the *wire drawing* effect of leakage water in spool valves.

This special APPLIED HYDRAULICS report will help you understand the designs of pumps, valves, cylinders, and accumulators for water systems.

PUMPS

A high pressure water system is usually designed with reciprocating plunger pumps. Their displacement is high, speed is slow. High speed rotary pumps cannot be used because of water's poor lubricity. Centrifugal pumps are used for low pressure water systems because of their compatability with water and their pressure—flow characteristics.

RECIPROCATING PUMPS

Think back to your grade school days and you'll probably remember the first pump you learned about was the kind every farmer had mounted on his kitchen sink. Simply a piston moving up and down in a cylinder, with two check valves to control flow in and out. Reciprocating plunger pumps work exactly the same way, except that a crank shaft replaces the farmer's strong right arm.

Design

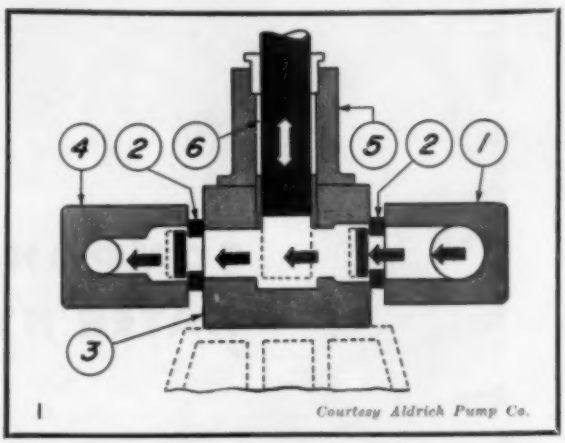
Both horizontal and vertical pumps are available, although vertical pumps are commoner because they take less floor space. The duplex horizontal pumps have higher pulsation and are limited to slower speed.

The pumping section of these pumps, called the fluid end, consists of the plungers and valves. Power stroke of the plungers may be either up or down depending on the construction of the pump. Several designs isolate the fluid end completely by driving the plungers by yokes connected to cross heads which are in turn linked to the crank shaft. In this design the power stroke is downward. Another design links the plungers directly to the crosshead stems using a connector and a special seal and scavenger pump to keep leakage fluid out of the power end.

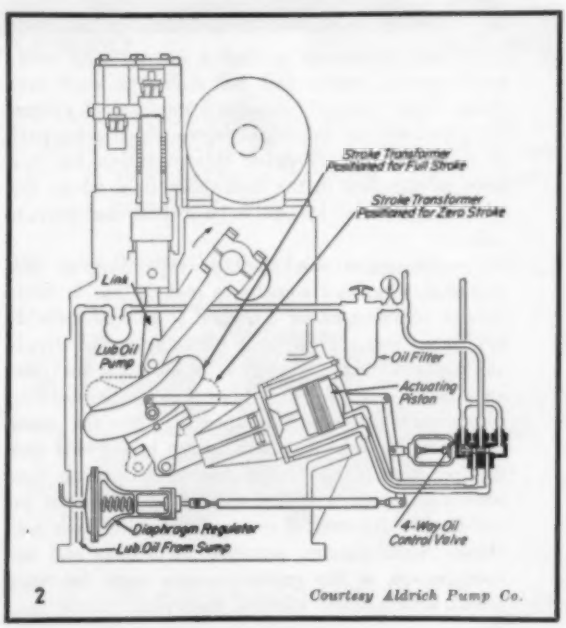
In one design, the fluid end is sectionalized as shown in the diagram. The advantage of sectionalized construction is lower cost of replacement parts. Both suction and discharge manifolds are separate units which are bolted to a forged steel working barrel. The valve assemblies, including valve seats which are held in place by the manifolding, permit removing the entire valve units. Removable stuffing boxes permit adapting other size plungers to the pump without removing the stuffing box liners. Because the body of the valve seat can be seen, any leakage around the valve seat is apparent.

One-piece cylinder forgings have the advantages of strength and leakage protection. Individual valves can be serviced without breaking pipe connections or removing all manifold bolts.

The driving section or power end of the reciprocating pump consists of the main frame, crank shaft, cross heads and connecting members. In designs having a yoke drive, the yokes are connected to the cross heads by plunger rods. Pressure lubrication is used and the lower half of the pump frame is the enclosure and reservoir for lubricating oil. These pumps may have a safety switch to insure proper oil pressure at all times.



1 Courtesy Aldrich Pump Co.



2 Courtesy Aldrich Pump Co.

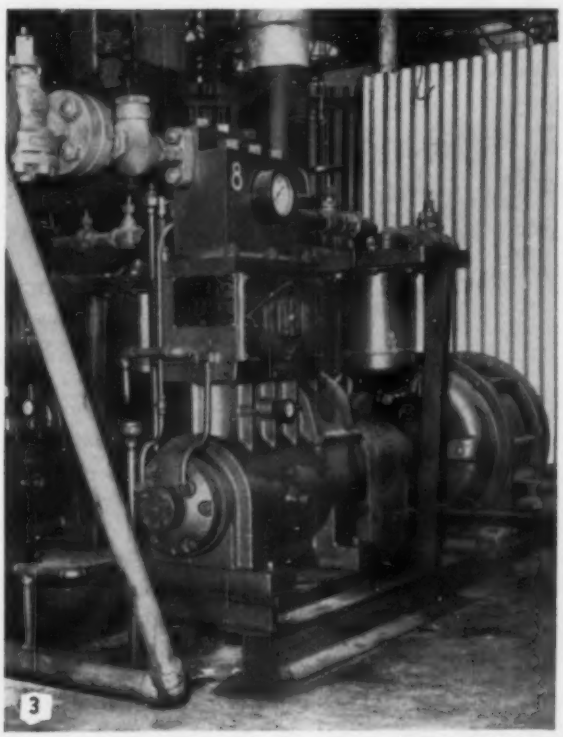
Performance

Delivery from a vertical reciprocating plunger pump depends on number of plungers, plunger diameter, stroke length and pump speed. Speeds are usually limited to 400 rpm or less for pumps of 5-inch stroke and larger. Shorter stroke pumps commonly operate at speeds to 750 rpm. The number of plungers may be 3 (triplex), 5 (quintuplex), 7 (septuplex) or nine (nonuplex). Pressure ratings range to over 20,000 psi for hydrostatic testing and laboratory applications, but most high pressure central systems are limited to 6000 psi. One leading manufacturer of reciprocating plunger pumps produces these in a range from 25 to 900 hp for fluid power applications.

Prime mover for the pump may be an electric motor, steam engine, steam turbine, or internal combustion engine. The drive can be direct connected through a flexible coupling or can be connected through a speed reducer mounted separately. Flexibility is one of the advantages of the separately mounted gear reducer. One of the most compact and inexpensive prime movers for large power pumps is a split-rotor synchronous motor mounted directly over a crankshaft extension with an outboard pedestal bearing. This arrangement eliminates gearing and requires minimum floor space. One design of reciprocating pump shown in Figure 3 is available with an integral electric motor and speed reducer.

When using electrical power, a synchronous motor may be used instead of an induction motor to obtain a better power factor and less load on the electrical lines.

Power factor of the induction motor is not only lower than that of the synchronous motor but is further reduced at light loads. Since the pump is loaded about 80 to 90% of the time in an accumulator system, use of a synchronous motor may be especially important in this application.



Courtesy Kobe, Inc.

FIG. 1. PUMP FLUID END is sectionalized for simpler maintenance, and consists of suction manifold (1), valve assembly (2), working barrel (3), discharge manifold (4), stuffing box (5), and plunger (6).

FIG. 2. PRESSURE-COMPENSATED, reciprocating plunger pump has stroke control to vary output. System pressure is sensed by instrument which transmits 3-15 psi signal to diaphragm regulator.

FIG. 3. POWER STROKE is upward on these pumps which have a special labyrinth seal to prevent leakage from entering power end. Leakage fluid collects in the spacer block and is removed by a seavenger pump.

Selection

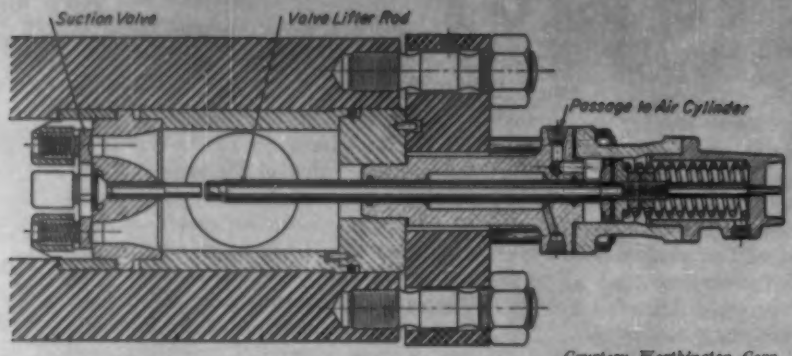
Sizing the pump for an accumulator system is usually based on average capacity requirements. Determining average capacity where a battery of presses is supplied requires an engineering study of the press duty cycle and production figures indicating how many presses are operated at one time. Some of the factors must, of course, be educated guesses with a margin for error and future expansion.

Variable Volume Pump

A variable volume, triplex, reciprocating plunger pump is used where a pressure compensated pump is prefered to a fixed capacity pump which can be unloaded. Design of the pump and compensating system is illustrated in Figure 2.

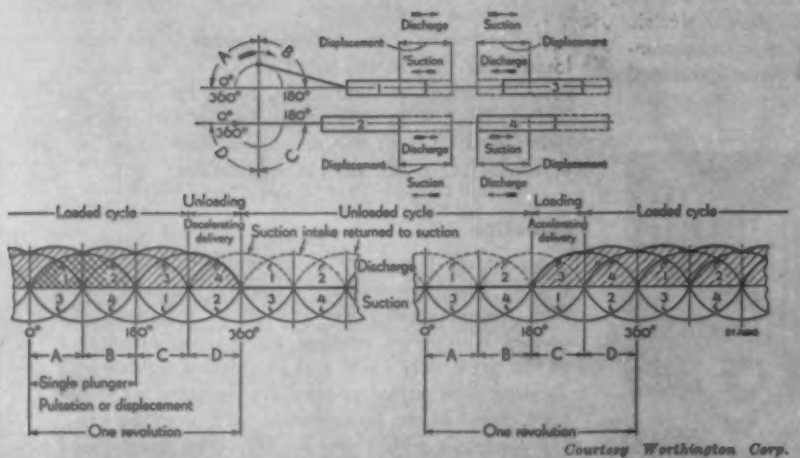
The stroke-adjusting mechanism consists of a link, stroke transformer, and actuating piston. In the condition shown in Figure 2 the actuating piston is fully retracted and the pump is on full stroke, and the slide block (connected to the lower end of the link) reciprocates in the stroke transformer. Extending the actuating piston reduces the pump stroke until the stroke transformer is in a horizontal position. At this point the delivery is zero because the connecting rod from the crank shaft merely reciprocates the link and slide block about the plunger pivot.

The actuating piston is controlled by the control valve which is supplied with oil from the lube pump. A pressure sensing instrument is connected into the hydraulic system and transmits an air signal between 3 and 15 psi to the diaphragm regulator according to system pressure. The diaphragm regulator actuates a linkage to control the valve. A follow-up linkage from the stroke transformer closes the valve when the pump is on the stroke



Courtesy Worthington Corp.

FIG. 4. VALVE LIFTER for synchronized unloading.



Courtesy Worthington Corp.

FIG. 5. CYCLE of synchronized unloading and loading on duplex, double acting pump.

SYNCHRONIZED

Most pumps operating in a central accumulator system are unloaded by a 2-way valve. While this is a simple inexpensive method of bypassing pump delivery, it can cause shock if the valve is operated quickly. Full system pressure is then suddenly applied against the check valve at the pump outlet. Consequently the diaphragm-operated unloading valve is usually slowed down to operate in 2 to 5 seconds. This reduces shock, but the high velocity flow through the valve increases wire drawing and heat generation.

Choice between a synchronized unloader on the pumps and a bypass valve depends on such factors as length of lines, pressure, and size of pipe.

To eliminate shock caused by unloading and loading the pump in an accumulator system, a synchronized unloading device is installed on the pump. In a reciprocating pump flow from each plunger starts from zero at the beginning of the stroke and increases smoothly to a maximum at midstroke. The flow then decreases smoothly to zero at the end of the stroke.

In synchronized unloading, the suction valves are held open by lifters. An electrical distributor is

required to maintain the pressure selected on the pressure instrument.

An advantage of this system is its small system differential pressure of 50 to 90 psi. This permits a smaller accumulator than would be required with a fixed displacement pump.

Packaged Pump

The pump shown in Figure 3 is a compact unit which is available with an integral motor and reduction gearing. Use of a special labyrinth seal between the fluid end and the power end permits the power stroke on the upstroke of the plungers. Leakage past the plungers collects in the spacer block where it is removed by a scavenger pump on the main shaft. The packing-less seal is a telescopic type in which two concentric sleeves extend upward from the bottom of the spacer block and are enclosed by a traveling sleeve attached to the crosshead stem.

Plungers are chrome plated and each is a lapped fit in its liner. This eliminates packing. Although leakage past the plungers is only about ½%, the design objective was not to eliminate all leakage. Some leakage is required for lubrication, and this is returned to the system by the scavenger pump.

Inlet and discharge valves are ball-type with stainless steel springs and followers. The hardened and ground valve seats are pressed into a tapered bore in the cylinder block and are easily removed and replaced with a pulling tool.

Corrosion is seldom a problem with this pump when 5% soluble oil is used, but in certain applications raw water is either the most practical fluid or is required by the job. One example is in hydrostatic testing of brass tubing where water containing soluble oil would leave a film that would have to be removed. The rust which may form on the cylinder liner during down periods makes the lapped plunger impractical for use with raw water, and a packed liner is used. A pressurized lubrication system delivers about a quart of oil every 24 hours to a felt ring in the liner. Extra packed liners can be kept in stock for fast replacement.

A 35-psi, supercharge pressure is recommended for these pumps because of the smaller spring-loaded ball type valves. This supercharge pressure also guards against starvation which is dangerous in any pump and can cause the valves to bang creating high valve maintenance. With the packed liners for raw water service, a supercharge pres-

UNLOADING

driven from the pump crankshaft at pump speed and controlled by a pressure switch or float switch on the accumulator. This distributor energizes solenoid air valves controlling the pump suction valve lifters. In one design shown, a spring in the valve lifter holds the suction valve off its seat except when air pressure acts on the rod end of the piston. In case of electrical or compressed air failure, the unloader fails safe with the springs holding the suction valves open to unload the pump. In synchronized unloading, each lifter completes its *extend* stroke during the suction stroke of the corresponding plunger, unloading all the plungers in sequence. Similarly in synchronized loading, the lifters are retracted in sequence during the suction stroke and the plungers build the flow smoothly from zero to maximum without shock.

The diagram showing plunger positions of a duplex double acting pump and resultant flow patterns illustrates that when the unloader operates during quadrant C of the crank motion, the plungers are unloaded in the sequence 1, 2, 3, 4. The device may function during any other quadrant. The diagram also illustrates that when the unloader functions during quadrant B to load the pump, the plungers load in the sequence, 4, 1, 2, 3.

Synchronized unloading is also available for pumps at speeds to 420 rpm.

TROUBLESHOOTING RECIPROCATING PLUNGER PUMPS

TROUBLE	CAUSE
Reduced output	Slow Speed
	Low suction head
	Air leak in suction line or stuffing boxes.
	Piston or plunger packing worn.
	Pump valves worn or hung up.
	Bypass valve not closed.
	Internal gaskets damaged.
Pressure won't build up	Piston rings worn.
	Bypass open.
	Suction valves hung open.
	Pump vapor bound.
Excessive vibration	Unsupported piping.
	Poor foundation.
	Misalignment.
	Poor suction conditions.
	Valves hung up.
	Broken valve spring.
	Main bearings loose or damaged.
	Too much crosshead guide clearance.
	Burned out connecting rod bearing.
	Foreign matter in pump.
	Loose side rod nuts.

sure of 100 psi is recommended to assist the downstroke during pumping.

Air-Driven Pump

When you need less than 5 hp, an air-driven pump may be economical. These come as complete units with air filter, lubricator, and regulator in single-acting and double-acting designs. Pressure ratings range to 23,700 psi with an air pressure of 100 psi.

An air-driven pump can supply six to eight presses where only a few presses operate at once, or where the curing phase is long. They can be used where a higher pressure than that of the high pressure line is required. For instance in one plastic operation, the press closes on low pressure, then 2000 psi is applied from the high pressure line, and finally 4500 psi is applied by an air-driven pump.

CENTRIFUGAL PUMPS

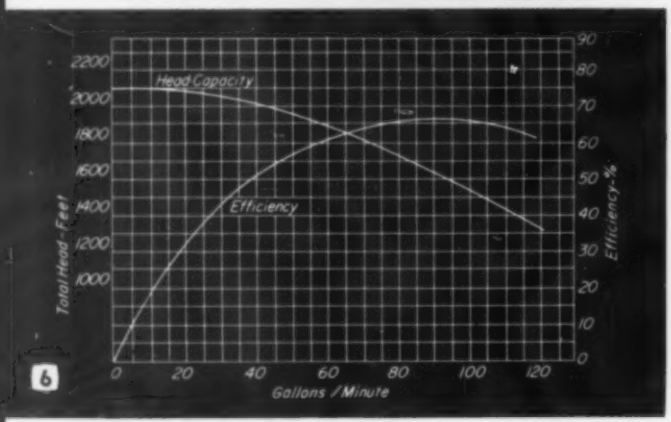
In two-pressure, central water systems common in rubber and plastic molding plants, the low pressure system is supplied either by centrifugal or reciprocating plunger pumps.

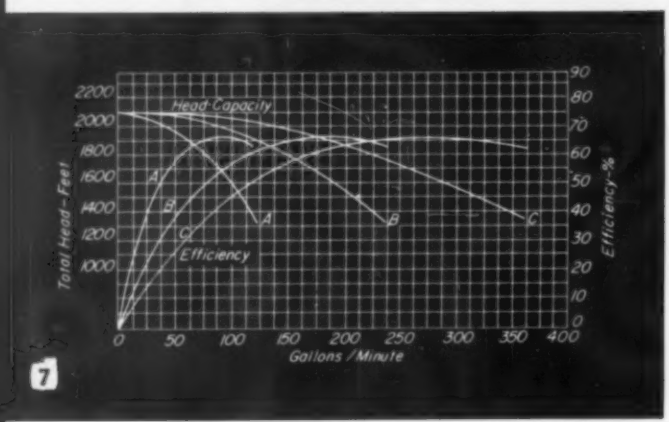
Fully loaded efficiency of reciprocating pumps is 85 to 92% which is higher than most centrifugal pumps. When unloaded, a triplex pump requires only about 10% of its maximum power. At shut-off, the centrifugal pump would require about 45% of its maximum power. So while the centrifugal pump costs less to buy, it costs more to run than a triplex pump.

Because centrifugal pumps have no close clearances which must be lubricated by the hydraulic fluid, they can be used for water operation, even when soluble oil cannot be added. The centrifugal principle gives a pressure compensated performance (Figure 6) which eliminates unloading devices. That is the pump delivers only the fluid required to maintain pressure in the system. A centrifugal pump can be operated at maximum pressure and no flow for short periods of time without damage, and with the addition of a small bypass can operate indefinitely at shut off.

Centrifugal Pumps For Diecasting

At the 1957 National Conference on Industrial Hydraulics, Thomas E. Hall of Byron Jackson Div., Borg-Warner Corp. described centrifugal pumps





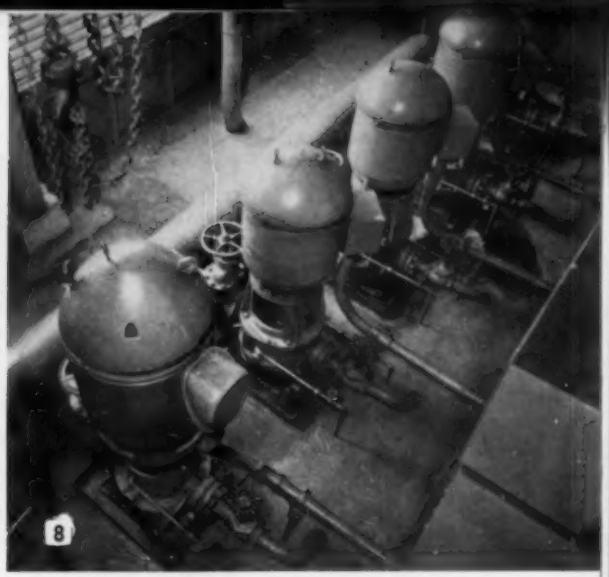


FIG. 6. PRESSURE COMPENSATION feature of centrifugal pumps is illustrated in these curves. This eliminates unloading devices.

FIG. 7. CONNECTING CENTRIFUGAL PUMPS in parallel gives deliveries shown. In an actual installation the pumps would be turned off or on according to the number of machines supplied. Curve *A* is for single pump, curve *B* is for two pumps in parallel, and curve *C* is for three pumps in parallel.

FIG. 8. FIVE CENTRIFUGAL PUMPS supply battery of die casting machines in this installation. Pumps were specially designed so that delivery-pressure curves match machine requirements.

directly supplying a battery of die casting machines without a central accumulator.

Centrifugal pumps are particularly good for this service. First, they will run on water which was selected for this operation because of its non-flammability and low cost. Second, centrifugal pumps can be designed with a flow-vs-pressure characteristic which closely matches the machine requirements. This boosts efficiency and eliminates relief valves and pressure compensating devices. Third, pressure pulsations in the system are reduced to a minimum because centrifugal pump output is inherently non-pulsating and the pump smoothly adjusts flow to correspond with pressure.

If a pump with the performance characteristics shown in Figure 6 were used to power a die-casting machine shot cylinder, the first part of the cylinder stroke would be very rapid because of the low pressure. As the resistance increased toward the end of the stroke, pressure would build up and flow would decrease along the pressure-flow curve. At the end of the stroke, flow would be zero and maximum pressure would be maintained. The pump can be kept in this condition long enough for the casting to set.

Connection of additional machines to the pump would move the initial operating point to the right on the curve because of increased flow demand. Initial operating pressure would be lower and machine movement would be slower. However, the same peak pressure would be obtained at shutoff. If enough machines are connected so that operating speeds become too slow for economical operation, additional pumps may be connected in parallel to modify the characteristic as shown in Figure 7. In an actual installation, the pumps would be turned off or on as the number of machines in service varied. This would have no effect on the final pressure during the cycle.

Centrifugal pumps for this service must be selected or designed to match the machine cycle requirements. By proper design, different pressure-vs-capacity characteristics can be produced without changing efficiency. Pressures of 1000 psi are common where vertical centrifugal units are supplying die-casting machines, and pressures to 1800 psi are frequently used. These relatively low volume pumps have deliveries of 100 to 150 gpm. On larger horizontal units delivering over 1000 gpm, pressures over 2000 psi are used. Connected in series, these pumps have been used for system pressures of over 6000 psi.

ACCUMULATORS

Accumulators in a central water system minimize power used and reduce pump size. Because all fluid must be stored at maximum pressure, two separate systems for high and low pressures are often used.

An accumulator maintains pressure by weights, springs, or compressed gas. The weight-loaded accumulator is the oldest type, is simple in design, and requires no auxiliary equipment such as an air compressor. However, it has several disadvantages. Among these are its high cost and great weight.

Weight-loaded accumulators may be so tall, that they must be mounted out-of-doors. Furthermore, the weight requires a very firm foundation and considerable space. For instance, a ram 10 inches in diameter requires 78 tons of weight for a pressure of 2000 psi. A ram 25 inches in diameter requires 490 tons for the same pressure. The 25-inch ram would have a stroke of 20 feet for a capacity of 510 gal. With the accumulator full, the overall height would be approximately 48 feet. Repairs which would require unloading the weight would be expensive and time consuming.

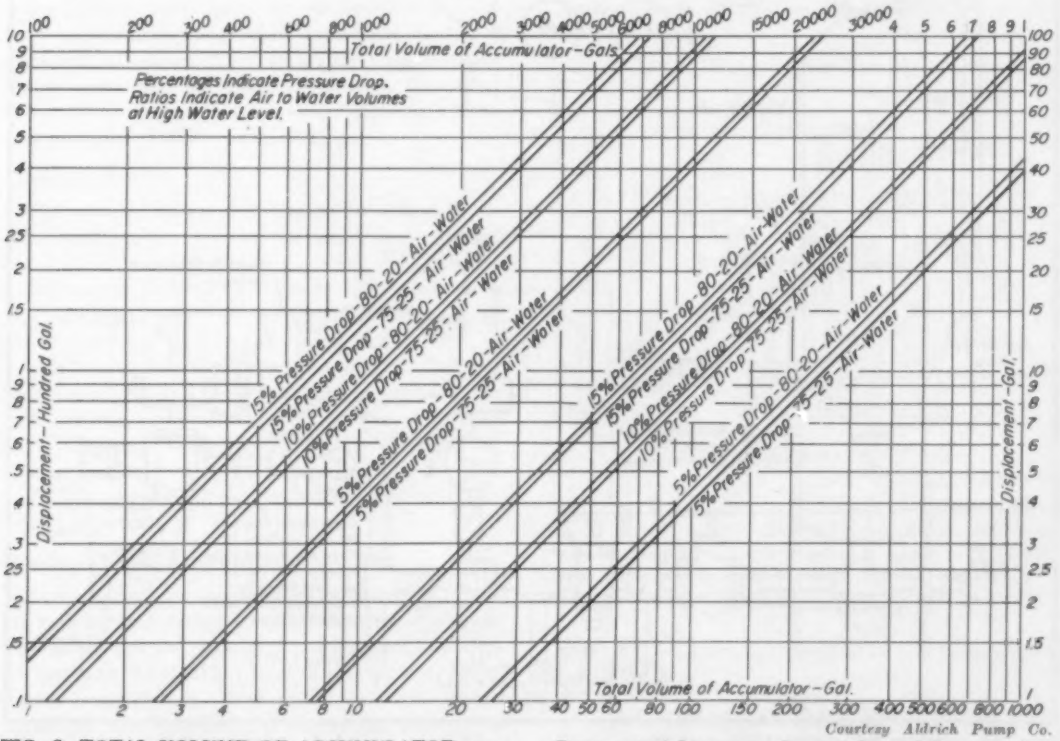
The inertia of the weight can cause water hammer in the system, and this limits the rate at which fluid can be delivered to the system. Inertia also limits the absorbtion of shock.

Even the general idea that the pressure in a weight-loaded accumulator is constant is not completely true. There is some pressure variation between static and moving conditions because of the inertia of the weight and the friction of the packings. Weight-loaded accumulators are a safety hazard because of the weight which can be released with a break in the system or by overfilling the accumulator.

Spring-loaded accumulators have performance characteristics similar to gas-loaded types in that the pressure varies with the compression on the springs. These accumulators are large for their capacity and are not used as much as gas-loaded types in present designs requiring large volumes.

GAS-LOADED ACCUMULATORS

The gas-loaded accumulator is a comparatively compact unit which also serves as an excellent shock absorber because of the compressibility of the gas. The compressed gas can either be in direct contact with the hydraulic fluid or separated by a piston or flexible bag.


Total Volume of Accumulator – Gals.
Percentages Indicate Pressure Drop.
Ratios Indicate Air to Water Volumes at High Water Level.
15% Pressure Drop – 80-20 – Air-Water
15% Pressure Drop – 75-25 – Air-Water
10% Pressure Drop – 80-20 – Air-Water
10% Pressure Drop – 75-25 – Air-Water
5% Pressure Drop – 80-20 – Air-Water
5% Pressure Drop – 75-25 – Air-Water
Displacement – Hundred Gal.
Displacement – Gal.
Total Volume of Accumulator – Gal.

Courtesy Aldrich Pump Co.

FIG. 9. TOTAL VOLUME OF ACCUMULATOR can be approximated from these curves when pressure drop and percentage of air to water are determined. Curves at right are read on right and lower scales. Curves at left are read on left and upper scales. Air-water ratio depends on accumulator proportions.

The non-separator accumulator, or air bottle, is being used more and more in central systems, because of its flexibility for future expansion. Air bottles can be used alone or in multiples in either series or parallel. Bottles can be added without difficulty, especially if space is allowed when the system is first designed.

Contrary to some opinion, there is little trouble from absorbtion of gas by the liquid. This is because: a. liquid is drawn off at the bottom, and b. saturation by gas virtually stops after it has reached a certain depth.

The compressed gas is usually air in a water hydraulic system, and nitrogen in an oil system.

Sizing

An important factor in sizing the accumulator is to keep a minimum fluid depth in the accumulator of 2 to 3 feet to prevent loss of gas into the system. This would not only cause a delay to recharge the accumulator but would be dangerous if the gas entered the low pressure exhaust or return lines. Because of its elasticity, the gas would not lose pressure as rapidly as the hydraulic fluid, and the lines would be subjected to overpressures.

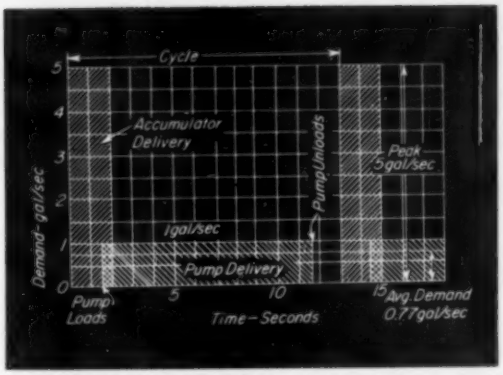


FIG. 10. DUTY CYCLE of typical central accumulator system. Accumulator supplies peak load of 5 gal/sec for 2 seconds. Pump delivers 1 gal/sec to the system for 10 seconds of the 13-second cycle. Average demand is .77 gal/sec.

Rate of fluid discharge must be considered when determining this minimum depth. A high velocity discharge from the bottle requires more residual water than a long slow draw. For lowest cost, the accumulator should be designed as high and small in diameter as possible. This keeps wall thickness to a minimum and reduces the required ratio of water to air.

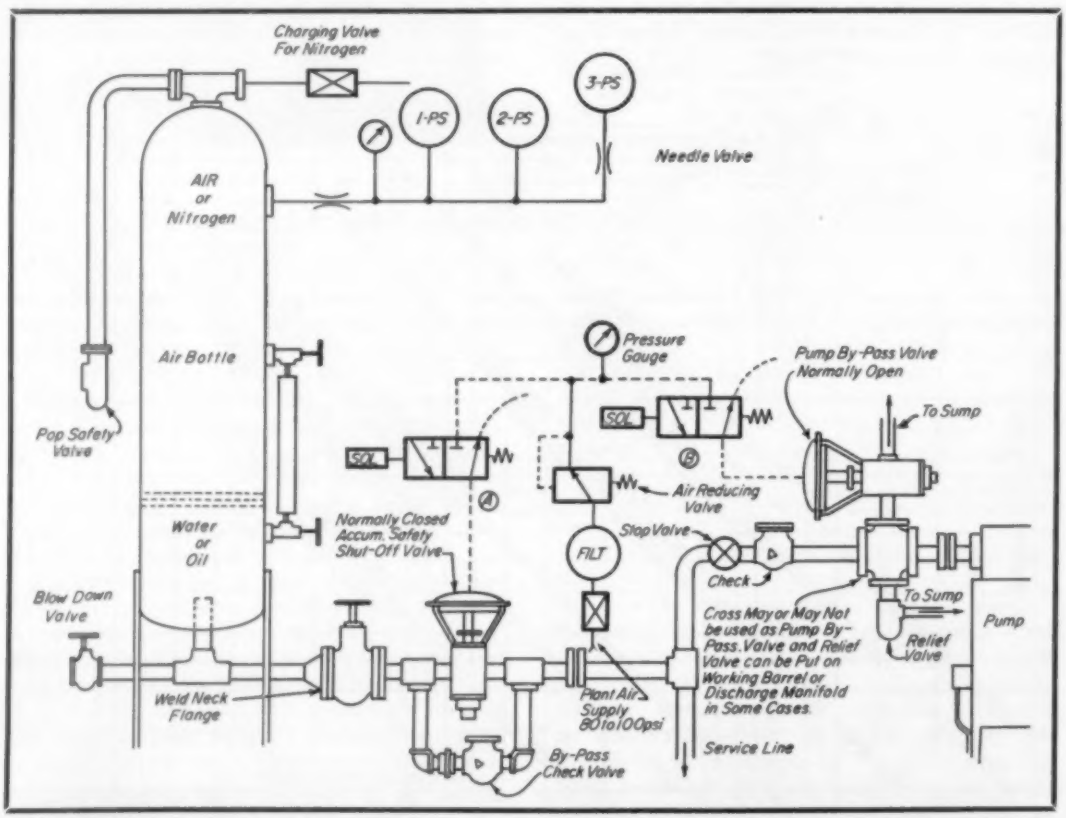


FIG. 11. PRESSURE SWITCHES CONTROL accumulator water level. 2-PS controls pump loading and unloading to maintain normal high and low accumulator water levels. 1-PS and 3-PS are safety devices to close shut-off valve and to prevent overpressure.

An automatic shut-off valve prevents the accumulator from being completely emptied and is connected in the fluid line to the accumulator to stop flow at the low liquid level. This valve closes only in emergencies, and it is a safety feature in case of an exceptionally large demand or failure of the pump delivery.

When fluid is released from the accumulator, pressure drops because of expansion of the gas. This drop is usually limited to 10% and is governed by the ratio of air to liquid in the accumulator. The greater the air-water ratio, the smaller the pressure drop per gallon of fluid withdrawn. Since an isothermal expansion is usually assumed in sizing the accumulator, with a pressure drop of 10%, the ratio of gas volume at the high liquid level to usable fluid is 9:1. With the reserve fluid, this ratio becomes 10.5:1 or 11:1.

Polytropic Expansion

While the assumption of an isothermal expansion is practical for sizing most accumulators, where fluid is discharged rapidly and pressure drop must be kept within close limits, a polytropic expansion should be assumed. The value of n in the formula $PV^n=C$ can be taken as 1.3. For a pressure drop of 10%, the ratio of air volume at high liquid level to volume of usable fluid is then 11.9:1 instead of 9:1 for isothermal expansion.

Temperature Effects

Temperature change can also affect pressure of a gas-loaded accumulator. An accumulator may be fully pressurized under cold conditions during a weekend shut-down. After resuming operation, the temperature may rise 20 to 30 degrees increasing the pressure about 5%. This would increase a nominal pressure of 4500 psi to 4725 psi.

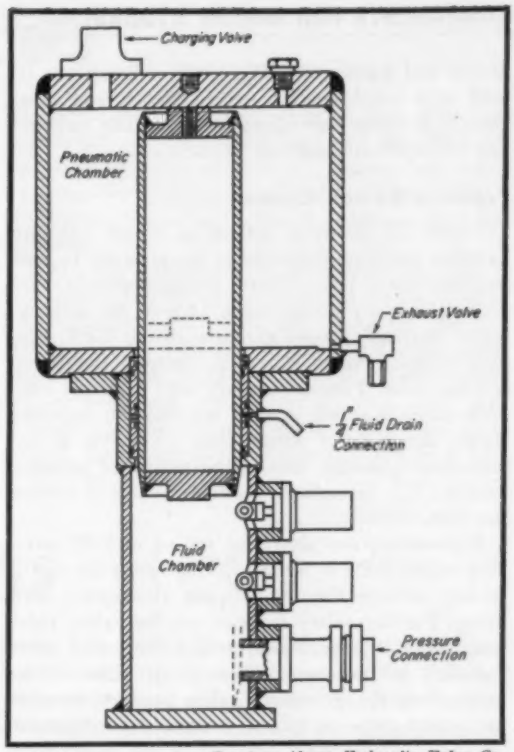
Compressor

The amount of air that has to be added to an accumulator after it is in operation is usually so small that the compressor does not have to run more than an hour or two a week. The compressor is frequently selected so it can completely charge the accumulator in 24 to 48 hours.

One hazard in adding compressed air is that hot particles may travel from compressor valves which have become carbonized from neglect or improper lubricating oil. These can ignite the oil vapor in the accumulator. A suitable separator in the line from the compressor to the accumulator will prevent this.

Bladder-Type Assemblies

The bladder-type accumulator is also used in water systems and makes a very compact installation. For water service, it is made with stainless steel fittings, and the shell is plated to prevent corrosion. These accumulators range to 10 gal, and larger capacities are obtained by connecting several in combination. Standard pressure ratings are 1000, 1500, and 3000 psi. Special designs with pressures to 10,000 psi and bag capacities to 100 gallons have been installed.



Courtesy Almar Hydraulic Valve Co.

FIG. 12. PISTON ACCUMULATOR is built for 3000 psi, 1 qt. to 10 gal. Hollow piston is part of compressed air chamber and reduces overall size. Cam-operated hydraulic valves are pad-mounted to the fluid chamber.

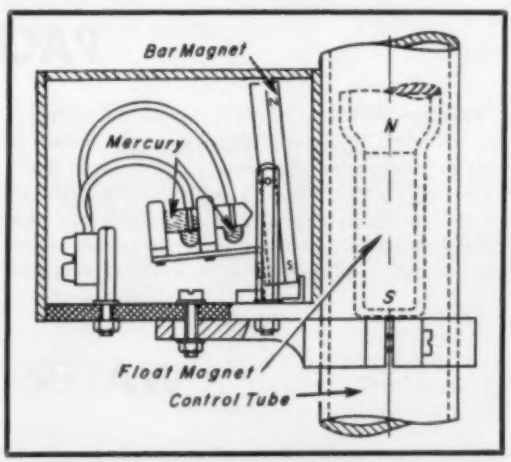


FIG. 13. MERCURY SWITCH CONTROL has magnet floating in a control tube at same level as accumulator water. This actuates the bar magnet and tilts the mercury switch to make electrical contact.

ACCUMULATOR CONTROLS

Controls installed with the accumulator actuate the pump unloader, shut-off valve and other pro-

tective and warning devices. Limit switches can be used with weight-loaded, spring-loaded, and separator, gas-loaded accumulators. Pressure switches can be used with bag-type accumulators.

Pressure Switch Control

Figure 11 shows a system in which pressure switches monitor accumulator air pressure to control the water level. Three pressure switches are connected to a pressure manifold from the accumulator. Normally closed pressure switch 2-PS actuates solenoid valve *B* which controls the pump bypass valve. Pressure switch 1-PS controls solenoid valve *A* which in turn actuates the normally closed accumulator safety shut off valve. If accumulator pressure falls to the setting of pressure switch 1-PS, the switch deactuates valve *A* closing the shut off valve.

If pressure rises above the setting of 2-PS, pressure switch 3-PS is actuated. This opens the motor starter holding circuit stopping the motor and pump. Further safety features are the safety valve installed at the accumulator and the relief valve installed at the pump. The pump relief is set lower than the air safety valve, because once an air safety valve is blown, it should be replaced. The pump relief valve can operate and reseat without damage. Water relief valves are also used on the accumulator in place of air relief valves because of more effective seating.

Use of Auxiliary Control Tube

One design shown in Figure 13 has mercury switches actuated by a magnet floating in a control tube. The tube is connected to the accumulator, so that the magnet floats at the accumulator water level. Each switch assembly contains a tilting magnet and mercury switch. As the switch magnet is tilted by the floating magnet, the mercury switch is also tilted and makes an electrical circuit.

Another type of control which also uses a control tube and float has induction coils fitted around the control tube. These coils are connected in an electrical bridge circuit which can energize a relay. A steel core in the float changes the inductance in the coils, energizing the relay to control pump loading or protective devices.

A third type of control has electrodes fitted into the control tube at various intervals. As the water covers the electrodes they conduct an electrical current and actuate a relay. A feature of this system is that there are no moving parts in the control tube.

Where floats are used in the control tube, the relative densities of the gas and the liquid at high pressures must be taken into account so that there is always enough difference to cover the total weight of the float. With air and water, the densities are equal at pressures just over 10,000 psi, and maximum working pressure with these devices is usually limited to 4500 or 5000 psi to insure sufficient buoyancy for the float.

PACKINGS

Packings should be carefully considered in applying cylinders to water. Neoprene swells considerably in water, especially when reinforced with duck. This swelling can occur in water with soluble oil as well as in pure water. Original packings supplied in most cylinders are synthetic rubber which work equally well with oil or water. However, wax impregnated leather packings are often selected for replacement because of their longer service life. Various waxes are used for either water or oil service, and this should be specified along with operating pressure and temperature range to get the right packing for the job.

WATER ADDITIVES

Most water hydraulic systems contain from 1 to 5% of soluble oil or other petroleum base soluble fluid to lubricate valve parts, ram bushings, pump plungers, and packings. This additive also conditions the water and helps metal parts resist corrosion. Such a compound should give lubricity as well as rust-preventive qualities to the water. It must contain non-petroleum materials which have great tenacity for metal surfaces. This gives a protective coating against rust forming impurities. The fluid should also be compatible with packings in general use, and it should be neutral with respect to either alkalinity or acidity for its entire service life.

One product is added to the system in the proportion of one gallon per 1000 gallons of water. Where a rust condition is worse than usual, a mixture of 1:500 is recommended. This additive is not a conventional emulsified mineral oil but has been specially compounded for water hydraulic systems. It goes into perfect solution with either hot or cold water, without curdling or forming lumps which might clog valves or cause gummy deposits.

CYLINDERS

Corrosion, chemical reaction, and abrasion are the main problems in applying cylinders to water systems.

Common protection is to chrome plate the piston rod and cylinder bore, and cadmium plate the end caps. Brass or centrifugal cast bronze cylinders and stainless steel piston rods are also used. Sometimes brass air cylinders can be converted for water application at pressures to 750 psi. If the cylinder has a cushion, the springs and balls are made from stainless steel.

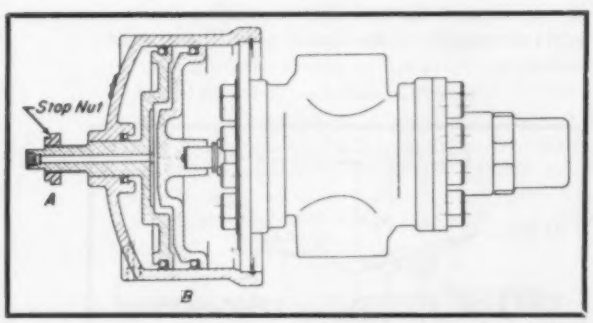
While these methods work well in most applications, if the water is very impure or dirty, you can expect trouble. In one steel mill job, cylinders with chrome-plated rods and bores were used with highly contaminated river water. In less than one month, the chrome plating corroded through and the cylinders would not operate. This was corrected by using Monel pistons and rods with centrifugal cast bronze bodies and a heavy cadmium plate on the heads.

In another installation, water which was highly contaminated with abrasive material scored the cylinder barrel and piston rod. Even the chrome plating was not sufficient protection. The problem was solved with a cylinder having a hardenable, corrosion-resistant liner integrally cast with the cylinder body. This liner was then hardened and ground. A separate liner can often do the same job at less cost.

VALVES

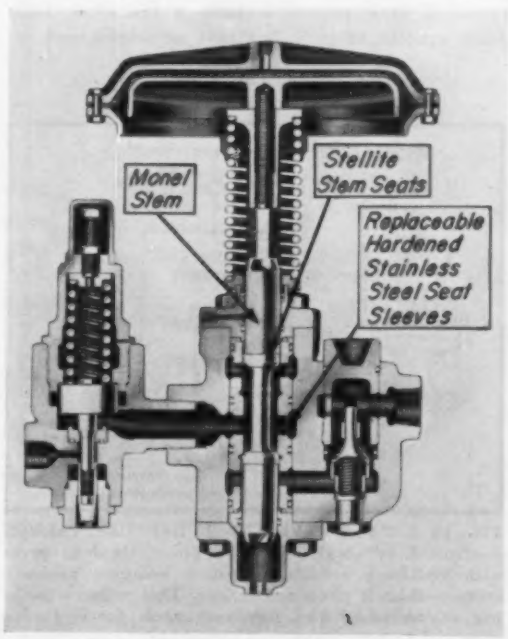
Wire drawing effect of water has pretty well ruled out spool type valves so common to oil hydraulic systems. The reason for this is the leakage necessary for effective spool valve operation. High speed water leaking through the annular passage around the spool would soon damage the valve.

Poppet type valves have been the rule in water systems, although shear-seal valves are also used in port sizes to 1½ inch. These may be either manually operated, rotary valves, or solenoid-operated, linear acting valves. The manually operated valves are available in 2-way, and 4-way types in sizes to 1½ inches for pressures to 6000 psi. Flow ratings are as high as 76 gpm at 20 fps in the 3000-psi, 4-way type. The valves can withstand velocities to 60 fps without modification.



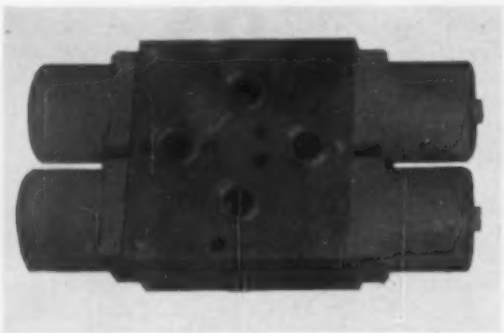
Courtesy Taylor-Emmett Controls, Inc.

FIG. 14. DUAL-PISTON VALVE gives deceleration before press closing or slow breakaway on completion of cure. Applying air pressure to port *A* gives full stroke of the valve stem. Air pressure at port *B* gives a partial stroke depending on the position of the stop nut.



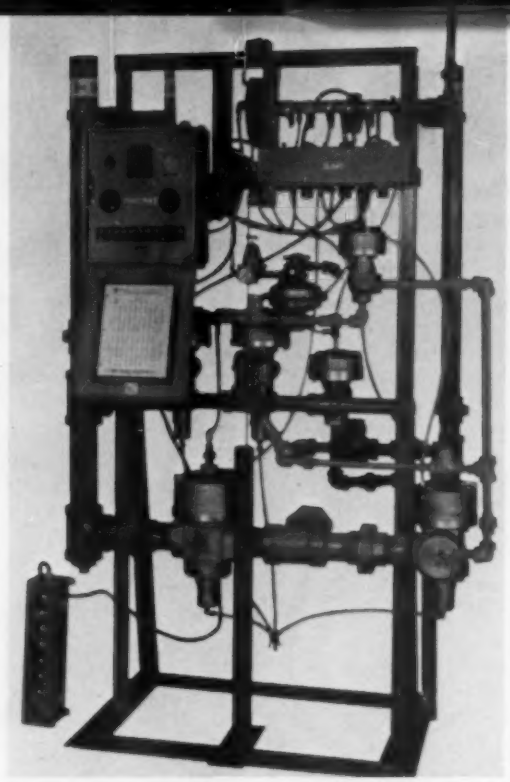
Courtesy Sinclair-Collins Valve Co.

FIG. 15. AUTOMATIC 2-PRESSURE VALVE directs high pressure fluid to press after ram closes on low pressure. Right-hand port is connected to low pressure system; left hand port is connected to high pressure system. When press closes, pressure rises and unseats high pressure piston, admitting high pressure fluid. This closes off low pressure check.



Courtesy Valv-Trol Co.

FIG. 16. 4-WAY, PISTON-OPERATED VALVE is manifold mounted and rated for 2000 psi.



Courtesy Taylor-Emmett Controls, Inc

FIG. 17. PACKAGE CONTROL SYSTEM for plastic molding press includes control panel, timer, hydraulic valving and air controls.

Solenoid-operated, shear seal valves are rated to 3000 psi in 2-way, 3-way, and 4-way types. Maximum sizes are ½ inch in the 4-way, 250-psi valve, and 1 inch in the 2-way, 250-psi valve. Other types range to ⅜-inch.

POPPET VALVES

Although poppet type valves are not as flexible in design as spool type valves, they work well with plastic and rubber molding presses. The operating cycles of these presses includes a fast close, high force squeeze or cure, *bumping* or release and reapplication of high force squeeze, and rapid opening.

Other requirements may include stop and hold for loading on the closing stroke or for unloading on the opening stroke. In plastic molding, the fast closing ram may have to slow down before contacting the work to avoid scattering the preform or to allow time for the material to flow. Slow opening may be required at the breakaway of the ram to avoid tearing the molding. Deceleration may be required at the end of the opening stroke to avoid damage from the knock outs. These actions

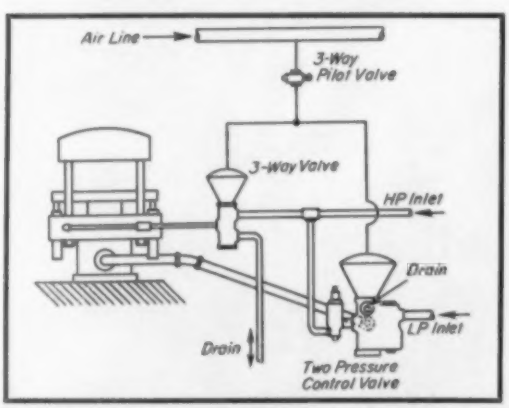


FIG. 18. 3-WAY VALVE AND 2-PRESSURE VALVES controlled by single air valve direct fluid to press with pull-back cylinders. System removes pressure from pull-back when not in use. This reduces packing maintenance and increases press force during cure.

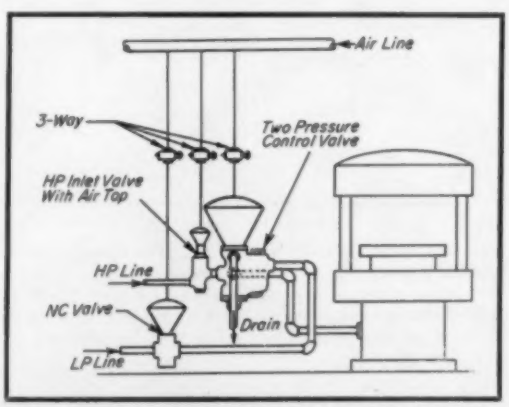


FIG. 19. LOW PRESSURE CLOSE AND HOLD is accomplished by fitting diaphragm top to high pressure inlet on automatic 2-pressure valve. High pressure is not applied until corresponding air valve exhausts this diaphragm operator. Normally-closed valve permits stopping press ram at any position.

are accomplished by combining 2-way, 3-way, and automatic 2-pressure valves with air controls as indicated in the illustrations.

Because plastic and rubber-molding presses are frequently up-acting, a 3-way directional valve can control flow to the main ram. When the press is operated from a 2-pressure system, this 3-way valve incorporates sequence control and is called an automatic 2-pressure valve. When the ram contacts the work, pressure rises to the setting of a poppet in the valve, and high pressure is then automatically applied to the ram.

Thirty-five psi was the standard air pressure when these valves first came into use, and they were designed with a pneumatic diaphragm to shift the valve stem. They are common today, but the design trend is to piston-operated valves operating on 100-psi air. These can also be operated on 35-psi air. They are more compact and have fewer parts. In one design, the piston operator is mounted with a single snap ring. O-rings are used for all static seals, and all moving seals are Teflon.

Although valves for water service have traditionally been pipe mounted, manifold-mounted valves are now appearing.

Of course materials and finishes in valves for water service must resist rust. Bronze and Monel are common materials. Valve seats are either Stellite faced or Teflon.

AIR CONTROLS

Much of the flexibility in controlling the cycle is due to the controls for actuating the hydraulic valves. Because these are usually air-operated, the air valving and how it is actuated is an important part of designing a complete system. The air valves are either manually operated or solenoid-operated. With solenoid-operated valves, a timer can be set up to control the system in the proper sequence.

A package control system, complete with control panel, timer, pushbutton control, and valving is shown in Figure 17. In this system, the common functions of plastic molding are selected as required by toggle switches on the control panel. Timing is controlled with rotary switches and pushbuttons.

PRESSURE CONTROL VALVES

In addition to directional control valves, pressure control valves including counterbalance valves, relief valves, and pressure reducing valves are also part of water hydraulic systems.

One pressure reducing valve for this service reduces 6000 psi to pressures as low as 100 psi. In one molding plant where this valve is used, hydraulic pressure is maintained in the main lines at 5000 psi and taken off for some of the presses at pressures from 3400 to 4200 psi. This close control of pressure has become increasingly important with newer plastics. ▼▼▼

The following men and companies contributed to this report:

Aldrich Pump Co., Allentown, Pa.

Almar Hydraulic Valve Co., Cleveland, Ohio

Anker-Holth Div., The Wellman Engineering Co., Port Huron, Mich.
W. L. Komph

Atlas Valve Co., Newark, N. J.

Barksdale Valves, Los Angeles, Calif.

Byron Jackson Div., Borg-Warner Corp., Los Angeles, Calif.
Thomas E. Hall

Greer Hydraulics, Inc., Jamaica, N. Y.
Seymour Garrett

Hannifin Co. Div., Parker-Hannifin Corp., Des Plaines, Ill.
J. J. Lansky

A. L. Henderer's Sons, Wilmington, Del.
W. E. Henderer

E. F. Houghton & Co., Philadelphia, Pa.
Howard Miller

Hydraulic Power Div., The Hydraulic Press Mfg. Co., Mt. Gilead, Ohio
G. R. Pittman

Ingersoll-Rand, New York, N. Y.

Institution of Mechanical Engineers, London, England
J. G. Frith, "Hydraulic Accumulators in Heavy Industry"

Jackes-Evans Mfg. Co., St. Louis, Mo.
John H. Marling

Kepner Products Co., Summit, Ill.
H. G. Kepner

Kobe, Inc., Huntington Park, Calif.
Theodore C. Ley

Kunkle Valve Co., Ft. Wayne, Ind.
W. L. Sexton

Benjamin Lassman & Son, Glenshaw, Pa.
L. Arthur Lassman

Ledeen, Inc., El Monte, Calif.
Harold Rosoff

Lindbergh Air & Hydraulic Div., Teer-Wickwire & Co., Jackson, Mich.
H. J. Rust, Jr.

Logansport Machine Co., Inc., Logansport, Ind.
H. L. Stewart

Sinclair-Collins Valve Co., Akron, Ohio
A. Angne

Stanley M. Proctor Co., Cleveland, Ohio
S. M. Proctor, H. W. McCracken

Rivett Lathe & Grinder, Inc., Boston, Mass.
J. A. Marsh

Seely Instrument Co., Niagra Falls, N. Y.

Taylor-Emmett Controls, Inc., Akron, Ohio
E. B. Sutherland

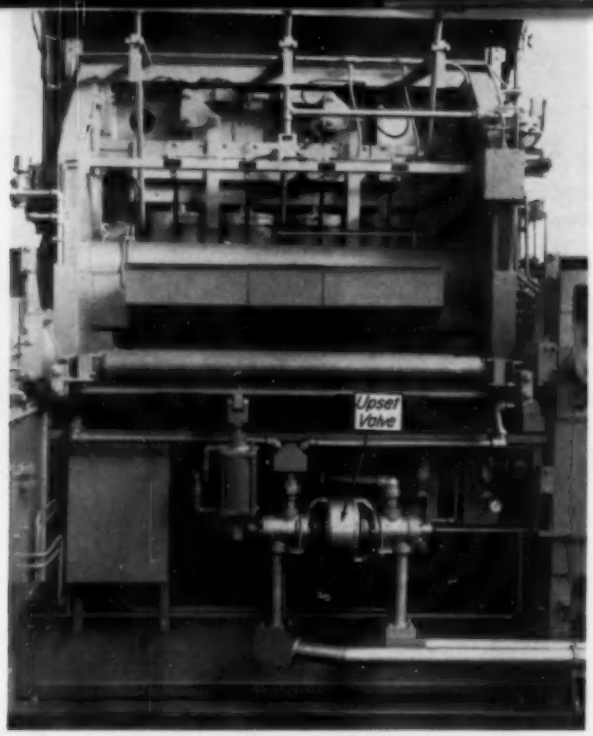
The Tomkins-Johnson Co., Jackson, Mich.
R. L. Curtis

The Valv-Trol Co., Akron, Ohio
H. L. Henry

C. R. Webber Machinery Co., Cleveland, Ohio
C. R. Webber, G. Webber

Worthington Corp., Harrison, N. J.
A. F. Welsh, R. K. Grobholz, L. Conklin, E. W. Theilig, W. J. Smith

HYDRAULIC power unit is a separate assembly. Two reciprocating plunger pumps are used. Air bottles increase capacity of a 20-gal piston-type accumulator to 120-gal.



UPSET VALVE is two valves, both 2-position, 2-way types. Individual bonnets are replaced by a single housing to give simultaneous operation. Three-position, four-way valve was used on oil-operated machine.

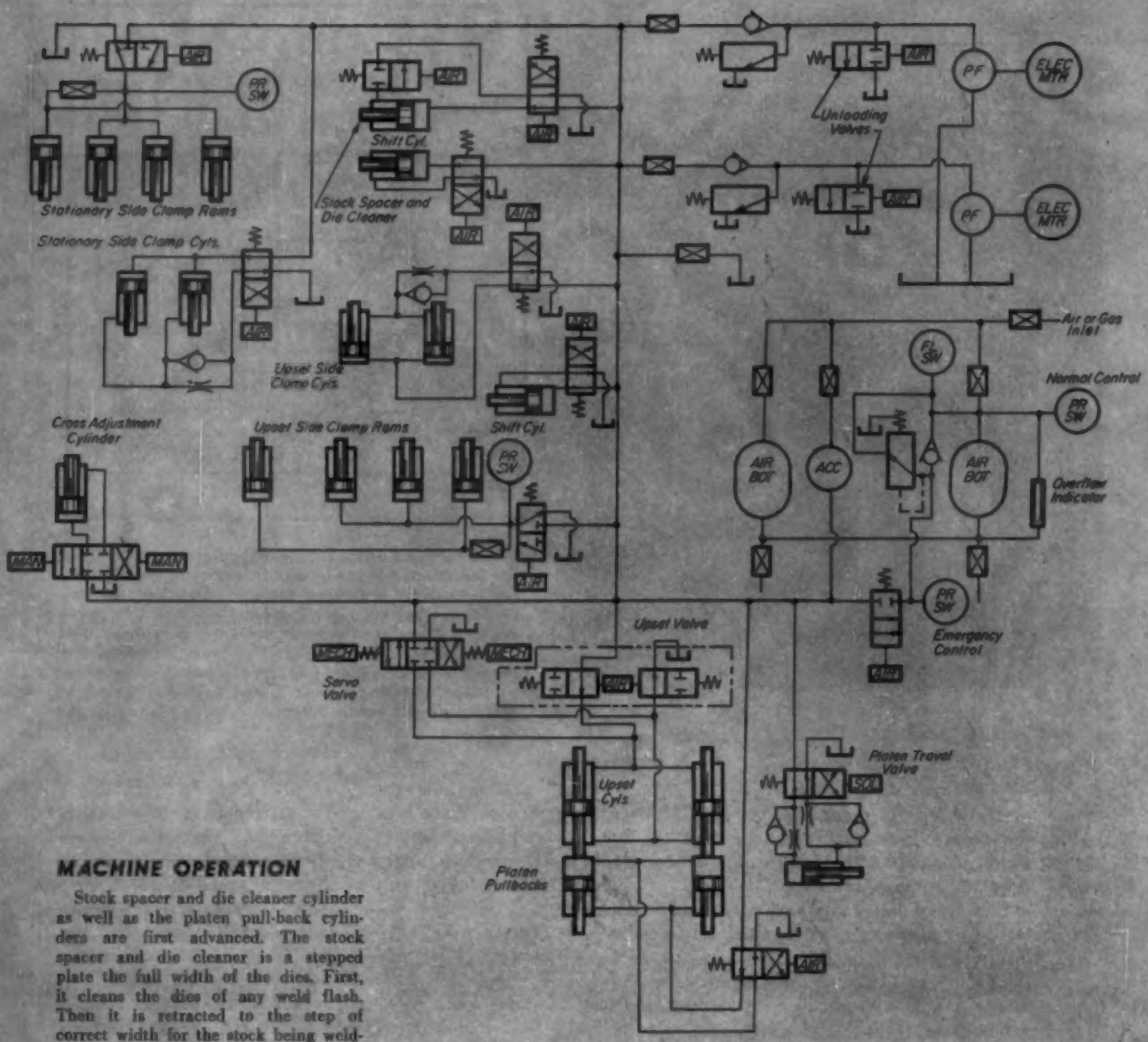
How an oil-hydraulic welder was changed to use water

• By Hans H. Hansen, *Chief Mechanical Engineer, The Taylor-Winfield Corp., Warren, Ohio*

When a customer asks that a machine designed to use hydraulic oil be modified to operate on water for safety reasons, what do you do? There's more to it than using a reciprocating-plunger pump. Valves and cylinders for water may not be interchangeable with oil types.

FLASH butt welding of steel strip is necessary to provide a continuous strip for processing in a modern strip mill. Hydraulics is used to clamp the strips being welded, properly position them, and push the ends of the strips tightly together while the weld is made. Many such machines using oil hydraulics are in use. Designing one of these machines for operation on water, with 5% soluble oil added, required quite a few design changes.

• **Power Supply**—Two reciprocating-plunger pumps are used in the power unit to supply water under pressure to the system. One pump is a standby unit which is needed because the machine is in a continuous strip line where downtime is extremely costly. Pump output is fed to the working circuit and to a 20-gal piston-type accumulator. Circuit fluid requirements would ordinarily require a larger accumulator. However accumulator volume is effectively increased to 120-gal by using two 50-gal gas bottles connected to the gas side. In most water hydraulic systems, the air-over-water or non-



MACHINE OPERATION

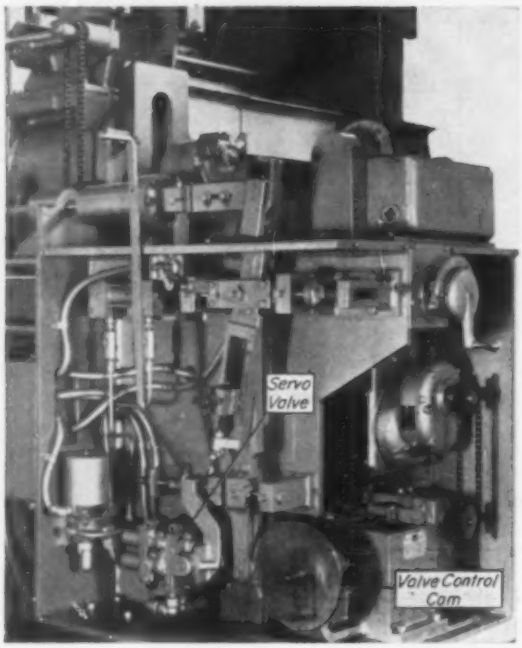
Stock spacer and die cleaner cylinder as well as the platen pull-back cylinders are first advanced. The stock spacer and die cleaner is a stepped plate the full width of the dies. First, it cleans the dies of any weld flash. Then it is retracted to the step of correct width for the stock being welded. Platen travel valve is then used to advance the die until it contacts the spacer.

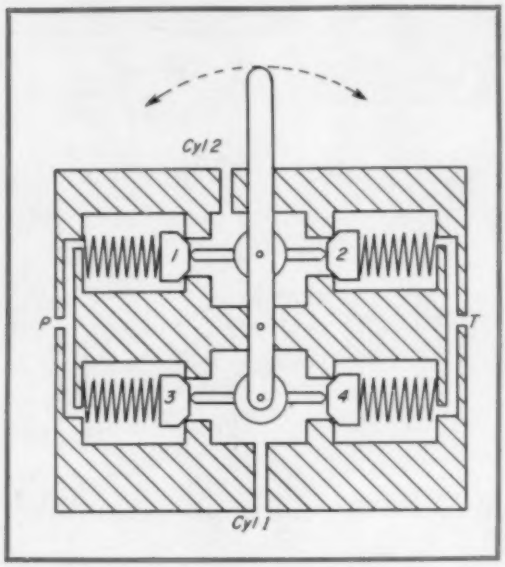
Clamping the sheets to be joined in the welding dies is next. This is done with four rams and two cylinders for both a stationary and a movable die. Initial, light clamping force is applied by two cylinders. When the cylinders move the upper clamping dies down to grip the work, limit switches energize solenoids controlling the air valves which operate valves controlling the clamp-bar shift cylinders. Shift cylinders then extend to move the frame, or clamp bar, on which the four clamp cylinders are mounted into position.

When the clamp bars are in position, the cylinders extend to apply high clamping force to the work. Extension is controlled by a limit switch. Shutoff valves permit use of only the two center clamp cylinders when narrow sheets are being handled. Pressure switches on the inlet sides of the clamp cylinders are safety devices which will not let welding current be supplied to the dies unless the sheets are firmly clamped.

With the sheets clamped, platen pullbacks, which have ½-in. stroke, are then retracted and the spacer withdrawn. Welding may now be started. The welding cycle is started by a push-button which applies welding current and starts the motor to drive the cam which moves the spool of the servo or follow valve. Upset cylinders then move the upset side dies and the sheet toward the other sheet as the sheets are heated by an arc maintained between them. At the correct time in the cycle, the cam energizes a solenoid air valve to operate the upset valve and apply full fluid volume to the upset cylinders. This forces the heated edges of the sheets together very rapidly to make the weld.

After a short delay to allow the weld to cool, sheets are unclamped and removed. Movable or upset side dies are then retracted.





FOUR-WAY, 3-position, closed-center servo valve for use with water is made up of four poppets. Poppets are opened by cams and plungers, closed by springs. Movement of the operating handle to the left opens poppets 1 and 4 to connect pressure to cylinder port 2 and connect cylinder port 1 to tank. Handle movement to right opens poppets 2 and 3 to connect pressure to cylinder port 1 and cylinder port 2 to tank. Cam for controlling the valve is visible in the photo.

separator type of accumulator is used. However, in this case, a piston-type was used to insure that no air or gas would enter the hydraulic system to make the action spongy or erratic.

Pump unloading and system pressure are controlled by a pressure switch which operates the unloading valve through a solenoid-operated, air-pilot valve to maintain pressure between 950 and 1000 psi. If this system does not function, the emergency pressure switch opens a 2-way valve to permit liquid to flow to a float switch through a sequence valve. The float switch opens, and the 2-way valve which admitted fluid to the sequence valve closes.

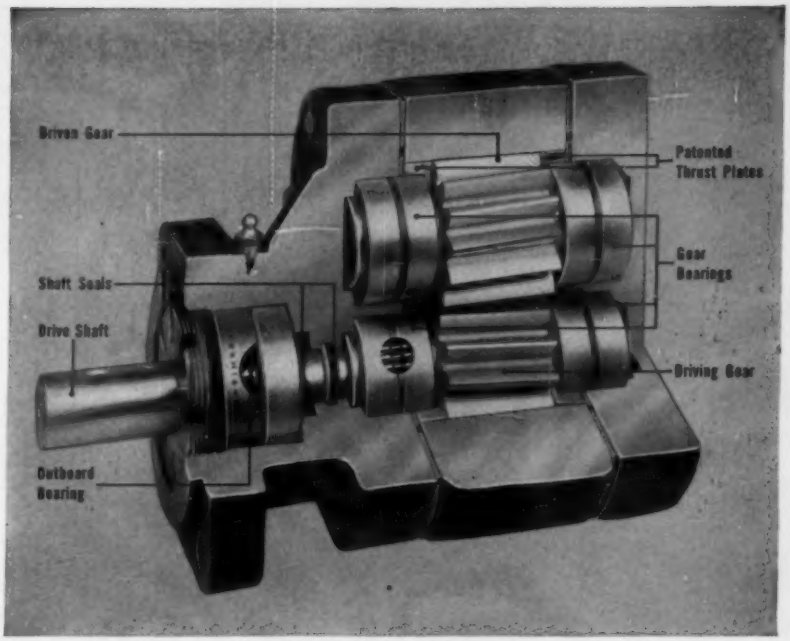
• **Valve Changes**—Water operation required replacing the oil valves with poppet-type valves. The servo or follower valve, which controls the rate at which the strips are forced together during welding, has four poppets operated by a single lever and operates as a 4-way, three-position, closed center valve.

In two instances, combinations of two valves were substituted for the usual 3-position, 4-way valves. A 2-position, 4-way valve and a 2-position, 2-way valve are used to control the stock spacer and die cleaner cylinder. This combination permits cylinder reversal as well as stopping the cylinder in any position. A 4-way valve similar to the servo valve could have been used if modified for pneumatic or hydraulic operation. However, the valve is commercially available only for manual operation, while those used are for air operation, as shown.

The upset valve is also a 3-position, 4-way closed-center valve in oil-operated versions of this machine. Two valves, both 2-position, 2-way types, are used here. This valve is connected in parallel with the servo valve at the end of the welding cycle to provide extremely rapid advance of the upset cylinders. Cylinder return is controlled by the servo valve, since the upset valve will permit flow in one direction only. To assure simultaneous and rapid operation of both sections of the upset valve, the valve bonnets were removed and replaced with a single cylindrical housing. The housing contains both diaphragms for valve operation and is strong enough to allow an increase of operating air pressure from 30 to 50 lb.

• **Cylinder Changes**—To assure long cylinder life, certain modifications were made to prevent corrosion as well as wear due to the relatively poor lubricating qualities of the water-oil mixture. All water-contacting steel parts were chrome plated. This decreases wear of rubbing parts and increases corrosion resistance. Some cylinder components were made from bronze rather than ferrous metals for increased corrosion resistance. ▼▼▼

ADVANCES IN HYDRAULIC PUMP DESIGN



Oil leakage controlled

In any method of mounting an oil-hydraulic pump there is always a certain amount of misalignment between the pump drive shaft and the shaft on the power source. Even where universal drives are utilized there is still the danger of a thrust load. Result in both cases: Flexing is transmitted into the pump seal and eventually to the bearings supporting the gear—leakage around the shaft is a sure-fire bet to follow.

At Commercial, by using an outboard bearing to protect the seals and internal bearings, the common leakage nuisance is eliminated.

Internal alignment perfected

Mass production of independent gear pump housing parts invariably results in varying degrees of internal misalignment—regardless of dowel pin control points used in machining. In many cases the "out" for the problem involves a loosening up on the internal tolerances —with a resultant loss in efficiency.

At Commercial, the patented thrust plate serves as a "natural" alignment control point—is counter bored on its face to match the bearing sleeve, then fits over the bearing sleeve and in turn pilots inside the gear housing. Perfect internal alignment—and increased efficiency—in any Commercial oil-hydraulic pump is axiomatic with rigid inspection of the thrust plate alone.

Constant volume assured

The principle of automatic adjustment of end clearance by internal pump pressure had one main weakness. The full pump pressure was applied against the whole area of each thrust plate. The plates would wear unevenly because on the inlet side of the pump the plate had full pump pressure on one face and a vacuum on the gear side.

By "pressure pocketing" Commercial insured that the pressures on opposite faces of the thrust plates would be in approximate balance around the entire area of the plate faces. Commercial's "one-two" advance design punch—the patented "pressure pocketed" thrust plate—assures constant volume at any pressure and at the same time helps to maintain simplicity of design and soundness of construction . . . provides for longer operating life and no maintenance headaches.

Seizing eliminated

Commercial oil-hydraulic pumps cannot seize because of heat induced by high speed or even inadequately piped systems. Variable end clearance and positive internal alignment make seizing practically impossible. Bearings evenly loaded throughout their length—no corner loading or spawling —are able to withstand much higher operating pressures. They stay in service longer too—regardless of pressures involved.

To take full advantage of tight internal tolerances Commercial designs, produces and grinds its own rotating gears—is able to hold extra close tolerances on tooth contours, outside diameters, and concentricity.

Over 5,000 different pump combinations—port locations and sizes—can be built from Commercial's standard line of oil-hydraulic pump components. A wide variety of drive shafts and mounting combinations are available to solve virtually any individual installation, piping and power application requirement.

Engineering help available

Commercial's oil-hydraulic pump engineering advances are typical of its complete line of oil-hydraulic equipment. The solid technical help Commercial sales engineers can contribute on the application of oil-hydraulic pumps, motors, cylinders and valves may be able to help cut your costs and improve performance.

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For more information write to Dept. A-5 Commercial Shearing and Stamping Company, Youngstown 1, Ohio. Better yet, send for your copies of Commercial's free engineering reference bulletins. Just check the items below in which you are interested.

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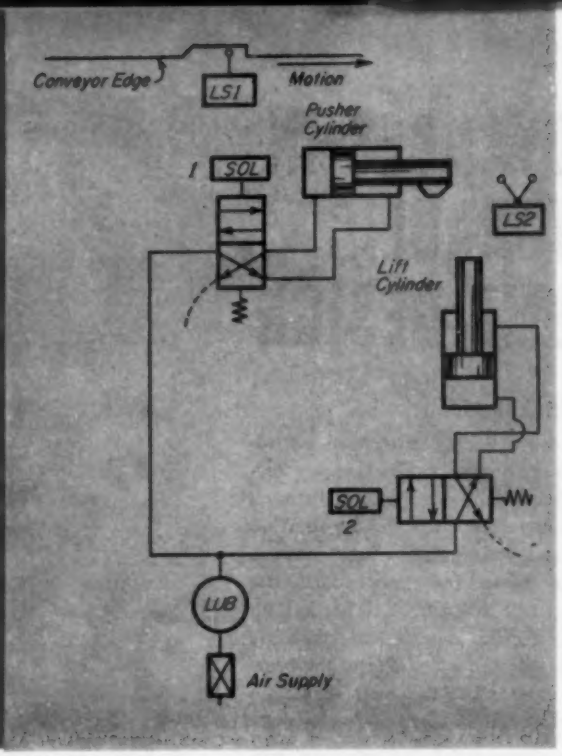

Air cylinders and controls add speed and eliminate manual effort at little cost.

Pneumatic mold pusher speeds casting handling

• By Henry Green, *Plant Engineer, Taylor & Boggis Foundry Co., Cleveland, Ohio*

MOLDS are pushed from a moving conveyor belt and tipped over onto another conveyor by an air-actuated pusher frame. This eliminates the need for two men. Additionally, the rate of production is increased. Two molds, each weighing as much as 400 lb, can be pushed off conveyor every 6 sec.

• **Operation**—A 4½ in. bore air cylinder supplied with 100-psi air extends the pushing frame to push the molds off the conveyor. As the pusher cylinder extends, a dog trips a limit switch to energize a solenoid valve and supply air to the 6-in. bore lifting cylinder. This raises the pusher blade. An angle at the bottom of the blade lifts the side of the mold flask to tip flask and mold onto an adjacent conveyor. This breaks up the sand mold.

When the pusher cylinder is fully extended, the limit switch controlling solenoid valve 1 is de-energized and the valve spring shifts to apply air to the rod end of the cylinder and retract it. Because the frame retracts in the raised position, two more molds can be moving into position while the frame is retracting.

When the frame is retracted far enough so that lowering will not interfere with molds on the belt, the limit switch controlling the lifting cylinder is operated to energize solenoid valve 2 and apply air to the rod end of the lifting cylinder. This lowers the frame to a horizontal position. When the pusher cylinder switch is again energized by the conveyor belt motion, the cycle is repeated.

If there is any electrical malfunction, the valve operating the lift cylinder is spring shifted to the *raise* position and the frame is immediately raised to prevent interference with the molds. Valves are dust-proof to prevent malfunction of the solenoids in this rather dirty operation. ▼▼▼

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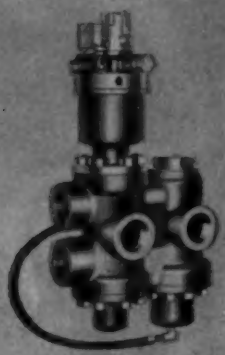
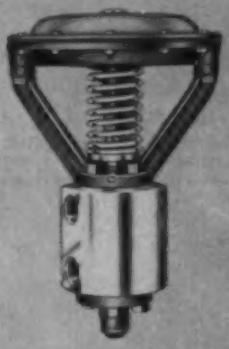


3000 PSI 4 WAY HYDRAULIC VALVE



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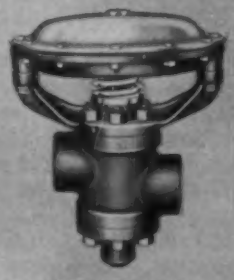

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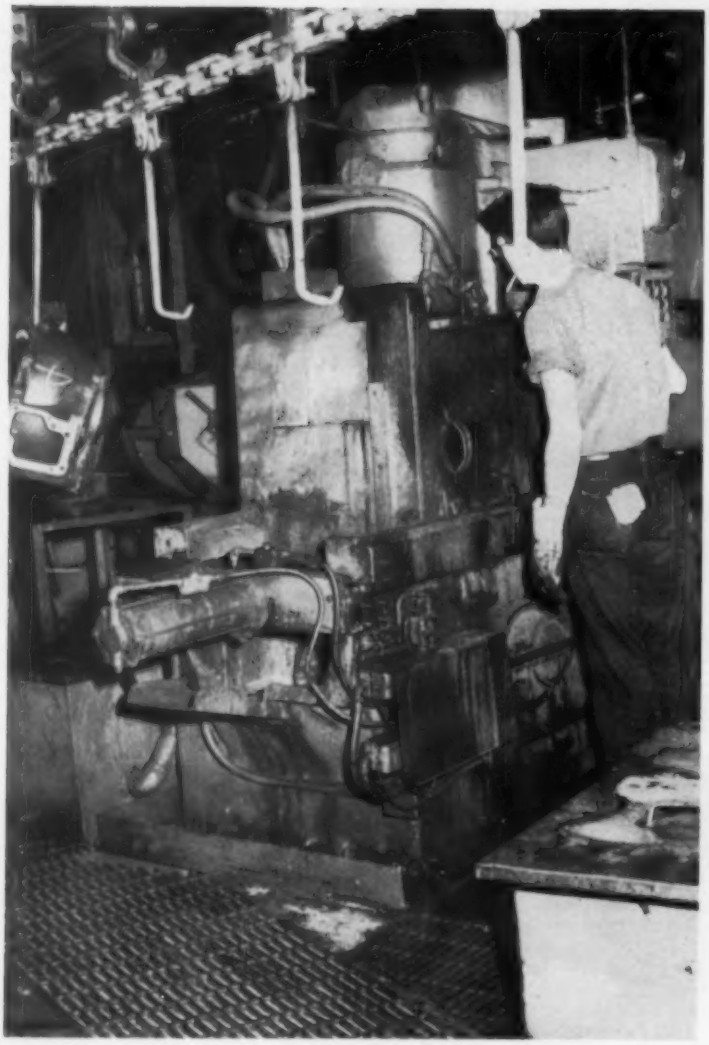


MOUNTING HYDRAULIC COMPONENTS on old machines often raises problems of limited space. The best place to install a fluid motor on this grinder was directly on

Fluid motor

WHEN heavier clamping tooling was added to a surface grinder at Chevrolet Transmission Plant in Cleveland, maintenance troubles began, and finally resulted in a redesign of the grinder using a fluid motor.

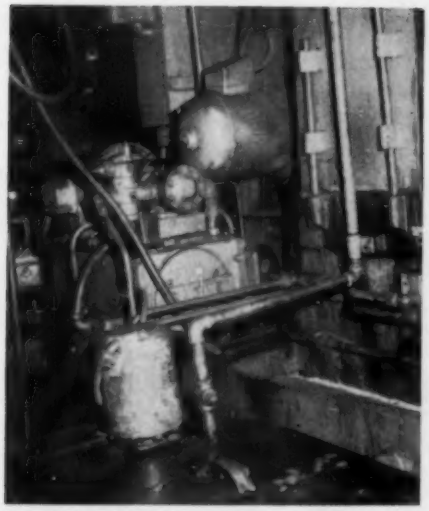
The original drive for the grinder table was a ¾-hp electric motor working through a shaft and reducing right-angle drive. Because the table has to move out from under the grinding wheel for loading, the connecting shaft had to telescope to accommodate both table positions. When heavier clamps were added for a 53-lb work piece, trouble developed with breakage of a bronze spline in the shaft.

Chevrolet tool engineers working with Pneu-Hydraulics, Inc., Cleveland, finally decided to elimi-

HOW SPEED AFFECTS TORQUE IN A FLUID MOTOR

Theoretically, torque produced by a fluid motor is a function of pressure. Pressure fluid acting on the total working surface area at a mean distance from the center of the shaft gives the theoretical torque. Running torque is less than this because of pressure drop due to fluid flow through the motor. As speed increases, the higher flow results in more pressure drop in much the same relationship as flow through an orifice. For higher speeds, less and less of the applied pressure goes into useful work. This pressure drop can be 10 psi per 100 rpm speed increase.

Slip also affects starting torque. In some cases, when starting under load, flow through this slippage path would be greater than that supplied to the motor. An increased delivery would produce full torque (as well as increased speed). If the motor really had insufficient starting torque based on too small a displacement, it would not start at a given pressure regardless of flow.



the right-angle drive. The unit finally selected for this application measures 13-3/16 inches long, 7-5/16 inches high, and 9-5/8 inches wide.

converts a grinder

nate the shaft by using a fluid motor driving directly through the gear reducer.. The problem then was getting a motor with sufficient torque and yet small enough to mount under the table in a space that was never intended for such an arrangement.

The first machine was modified with a fluid motor having a displacement of 1.57 cu. in./rev. and a theoretical torque of 25 lb-in/100 psi. Actual running torque is only 90% of this, and starting torque ranges from 75 to 80% of this theoretical value. Although the motor fitted into the limited space, it did not produce the required torque.

The motor which has been applied successfully is a rotary abutment type producing a torque of 35.8 lb-in/100 psi with a starting torque essentially the same as the running torque. This unit has a displacement of .01 gal/rev and can operate in the low speed range from 50 to 300 rpm. ▼▼▼

The January 1958 *issue of APPLIED HYDRAULICS lists all manufacturers of fluid motors and charts what types they make. For more information about this issue see p.* 128.

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HIGH PRESSURE NEEDLE VALVE

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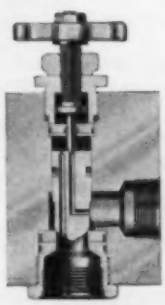
MICROMETER ADJUSTMENT NEEDLE VALVE

Best for extra fine metering. Micrometer adjustment, precision taper stem. 5000 psi service −65° to 350°F., oil, water, etc. Brass, aluminum alloy, steel, or stainless steel body. ⅛" and ¼" sizes. Premolded or O-ring packing. Panel mounting.



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Accurate throttling up to 5000 psi. Finger tip control. Pilot operation of large dynamically balanced piston. Full flow, yet accurate to 1/100 gpm through entire range. Positive seal. Low pressure drop. Aluminum alloy, ½", ¾", 1" internal straight thread connections. Hydraulic seals — others available.

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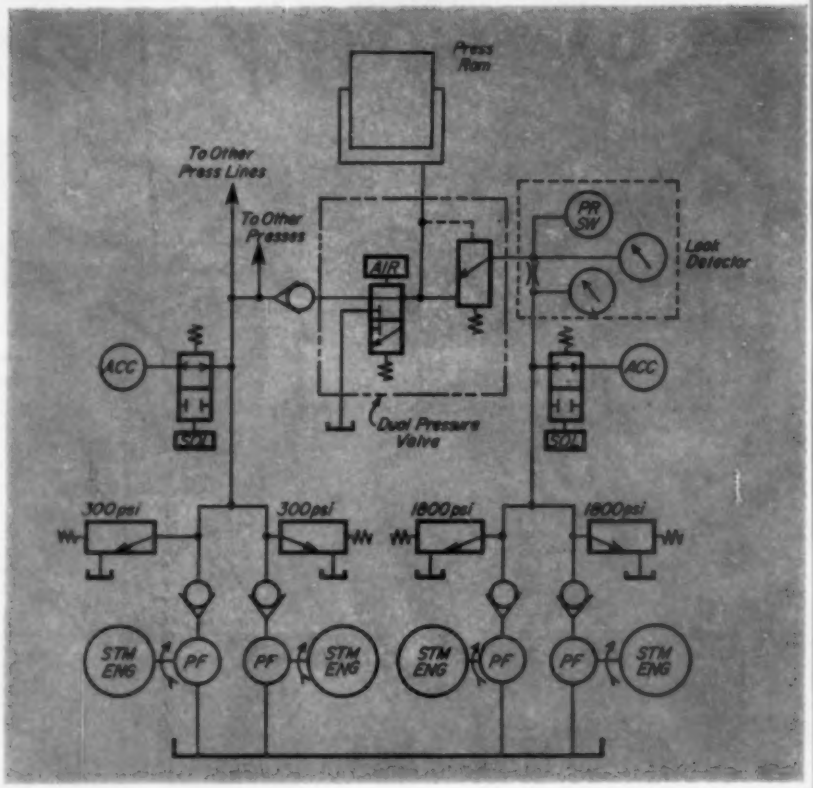
How to find leaks in a central hydraulic system

Water is the cheapest hydraulic fluid. With water, small leaks can be ignored. But big ones must be fixed. Otherwise too much pressure is lost. To seal a leak, one must first find it.



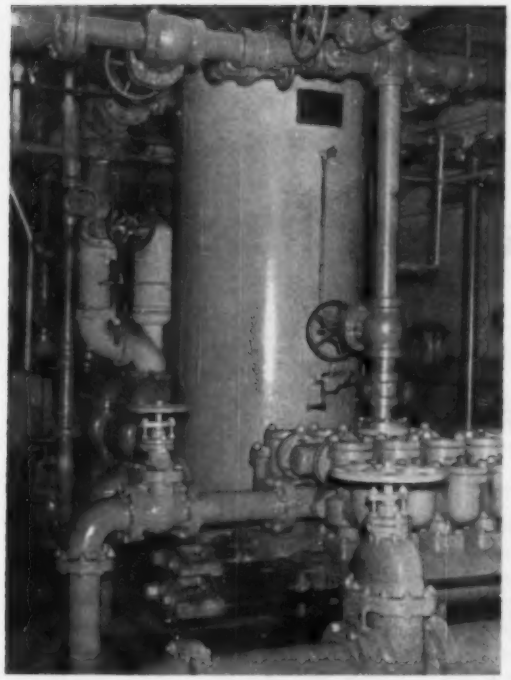
IT'S often hard to find a leak in a really large hydraulic system. Internal leaks are extra hard to find. With 150 rubber-molding presses operating on 19 separate press lines, location of a leak can be a job. Particularly when it is an internal leak from the high-pressure side of the valve to the tank port. To simplify leak detection and speed the necessary repairs, a system for pinning the leak down to a press line has been installed at the Dryden Rubber Div., Sheller Mfg. Corp., Chicago, Ill.

• **Hydraulic system**—Four duplex reciprocating pumps, driven by steam engines, supply water at 300 psi and 1800 psi to two accumulators and the 19 press lines. Pumps are independently driven, and only one high-pressure and one low-pressure pump are operated when system demands are low. Accumulators have low-level, solenoid-operated, shut-off valves to prevent loss of air charge.

High and low-pressure water are supplied through headers to a dual-pressure pneumatically-operated valve at each press. When this valve is shifted to the *on* position by supplying air to the valve diaphragm, low pressure water is supplied to advance the press ram until resistance is met. The valve then automatically closes the low-pressure line and admits high-pressure water to the ram. Thus, high-pressure water is supplied for only a small portion of the ram stroke and for holding during the curing process. Removing pressure from the valve diaphragm, connects the ram to tank and gravity retracts it.

• **Leak Detecting System**—Since high-pressure water is supplied during such a small portion of the operating cycle, there is ordinarily little flow in the high-pressure lines. Leak detection is, therefore, accomplished by placing an orifice (or constriction) in the high-pressure line just ahead of each press line. Pressure gages are installed on both sides of the orifice and a pressure switch on the downstream side. Any appreciable difference in the reading of the two pressure gages indicates leakage flow in the connected system of that line.

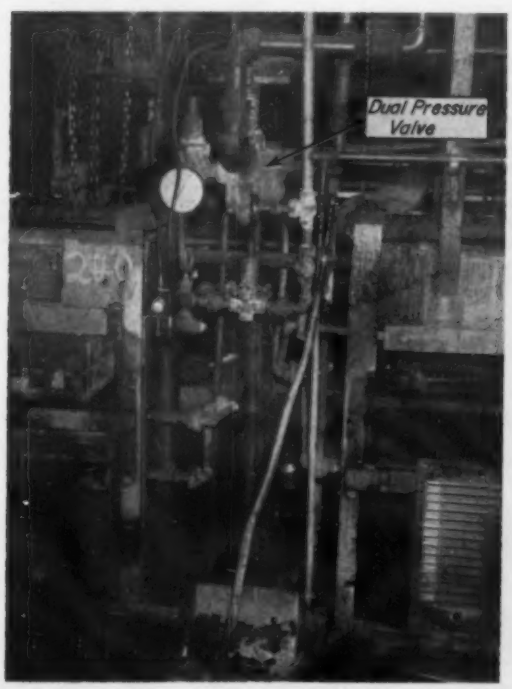
Although this method could be used to tie the leak down to a specific press, localizing the leaking press line is sufficient. When maintenance personnel see a difference in gage readings, they start looking for the leak before it is very bad. If the leakage continues to increase until pressure on the downstream side of the orifice drops to 1200 psi, the pressure switch closes electrical contacts to sound an alarm. ▼▼▼



FOR OPERATION of 150 rubber molding presses, high and low-pressure accumulators store fluid from horizontal duplex reciprocating-plunger pumps shown at bottom.

CIRCUIT DIAGRAM of the central hydraulic system for operating 150 rubber molding presses.

DUAL-PRESSURE VALVE automatically shuts off low pressure line and connects high pressure when ram nears the end of its stroke. Valve is air-diaphragm operated.



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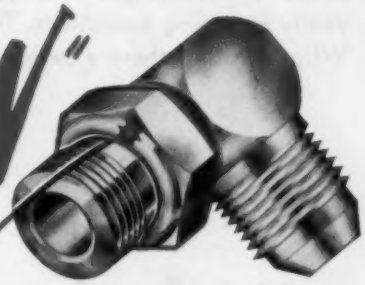

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- Assemble and reassemble without damage to port or fitting—assures positive seal.
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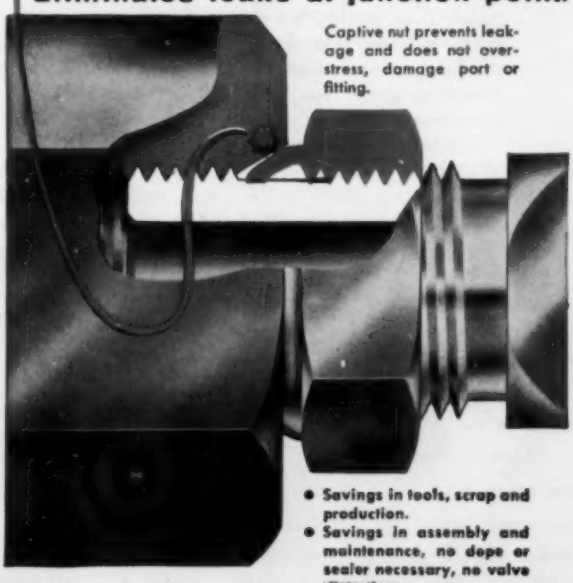
Eliminates leaks at junction point.

Captive nut prevents leakage and does not overstress, damage port or fitting.



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- Savings in assembly and maintenance, no dope or sealer necessary, no valve distortion.

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CIRCLE 60 ON PAGE 97

About 10 million gallons of petroleum hydraulic fluids are used yearly in mining operations. The fire hazards are great. Why then isn't there a switch to fire-resistant hydraulic fluids?

Cost keeps fire-resistant fluids out of mines

• By S. P. Polack *Mining Health & Safety Engineer*
United States Department of the Interior, Bureau of Mines

A BUREAU of Mines survey was conducted to determine the quantity and type of hydraulic fluid used in operating coal-mine equipment. The 678 mines surveyed used 3,495,557 gallons of hydraulic fluid in 11,496 units of mining equipment during the period studied. All fluids were petroleum products, and therefore flammable.

COST FACTORS

Information from mine operators, equipment manufacturers, and producers of hydraulic fluids, indicate that fluids are purchased on price basis rather than quality for safe and efficient use. Reports indicate that during the guarantee period, the fluid recommended by the manufacturer is used. However, price then generally becomes the chief consideration.

Several fire-resistant hydraulic fluids are now available:

STRAIGHT SYNTHETIC FLUIDS—phosphate ester and chlorinated hydrocarbon compounds.

WATER-BASE SYNTHETIC FLUIDS—mixtures of water, polyglycols, and additives.

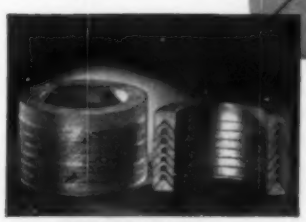
EMULSIONS—water and oil emulsions.

The cost of these fluids virtually precludes their use in mining equipment in competition with low-priced products now generally used. However, conferences with numerous producers show that, within a reasonable time, their cost will compare favorably with the flammable products now used.

The low-grade fluids perform at least to a tolerated degree of acceptance by the users or they would not continue to use them. Any fire-resistant hydraulic fluids developed at a price comparable to the cheaper fluids now used, should not be expected to perform as well as the more expensive fire-resistant fluids now available.

Hydraulic fluid survey

Bureau of Mines office	Cutting machines	Loading machines	Drills, roof-bolters, timbering machines	Shuttle cars	Continuous miners	Hoists, car-spotters, compressors, etc.	Hydraulic fluid used (gallons)
Pittsburgh, Pa.	546	685	248	530	124	93	1,544,480
St. Clairsville, Ohio	72	151	87	129	15	6	23,589
Birmingham, Ala.	83	129	71	187	7	83	110,217
Johnstown, Pa.	115	182	59	253	61	32	101,447
Norton, Va.	134	328	111	389		7	77,510
Barbourville, Ky.	55	153	23	163		14	74,039
Seattle, Wash.		2			6		1,140
Vincennes, Ind.	230	300	201	521	12	37	150,159
Morgantown, W. Va.	207	326	260	325	25	21	161,345
Mt. Hope, W. Va.	481	978	246	1,036	58	151	947,814
Denver, Col.	127	200	108	209	9	23	300,662
Jellico, Tenn.	12	21	1	11			3,155
TOTAL	2,062	3,455	1,415	3,753	317	467	3,495,557
Hydraulic system capacity—range in gallons	20 to 90	7 to 50	15 to 100	5 to 30	33 to 180	10 to 40	



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CIRCLE 38 ON PAGE 97

CIRCLE 39 ON PAGE 97

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PRODUCTS

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Model 3040 Oil-less Air Pump. Vac. to 20", pressure to 10 p.s.i. To 24 c.f.m., ¾ to 1½ h.p.

Oil-free air blast with carbon-vane

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You also eliminate lubrication problems when vacuum or pressure pump is mounted in a hard-to-service location.

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See Catalog in Sweet's Design File

Write for Oil-less Bulletins 152A and VP-356. **GAST MANUFACTURING CORP.**, P.O. Box 117-D, Benton Harbor, Michigan.

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FLUIDS FOR MINING EQUIPMENT

FIRE HAZARDS

The possibility of the hydraulic fluid becoming involved in any fire can not be overlooked. During a period between July 1952 and January 1957, the Bureau of Mines investigated 160 coal-mine fires. 91 were initiated electrically. Hydraulic fluids contributed to the fire or became involved after the ignition in some of the fires. The following are excerpts from investigation reports.

> **Colmol and shuttle car.** Trailing cable crushed between bumpers of Colmol and shuttle car, causing short circuit. Position of shuttle under the rear conveyor of Colmol further hampered efforts to smoother the fire, which increased in intensity because of hydraulic oil.
>
> **Continuous miner.** 56 gallons hydraulic oil capacity. Bumped by shuttle car, trailing cable damaged. Arc from short circuit ignited insulation and loose coal lying on machine. Fire spread to nearby hydraulic hoses which ruptured. Escaping oil burned.
>
> **Mining machine.** Short circuit in a cable leading from the control panel to the cutting motor. Resultant fire ignited accumulations of oil-soaked coal dust and fine coal beneath the top cover plate of the machine. About 50 gallons of hydraulic oil in the tank were vaporized and consumed by fire.
>
> **Mining machine.** 30 gallons hydraulic oil. Fire was the result of an arc produced by the mining machine running over the trailing cable. This ignited hydraulic oil spilled on the machine. Hydraulic hoses were scorched but fire was put out before they burned.

OPERATING CONDITIONS

Operating conditions in coal mines are extremely severe. Mining machinery must usually operate in a limited area. The coal varies in hardness and is often studded with impurities. The floor over which the machine has to travel can be rough and changeable as to grade. Difficulty in travel causes many severe bumps and strains. Often a machine will work with one of many operational units, and there may be frequent bumping between such machines. This bumping loosens bolts and joints and causes distortions, or tightening. This causes increased friction and greater internal heating.

It is not feasible to move a machine from its working position—often 5 or more miles from the surface or underground repair shop—for repair or adjustment. Repairs are generally made in the restricted area where the machine operates, usually under adverse conditions. Work is performed in poor light—generally by the cap lamps the men wear.

Leakage reduces the quantity of fluid in the hydraulic system and causes extra heating as the fluid level in the tank drops and the heat-exchange factor is reduced. Leakage also adds to the accumulation of loose coal dust, grease and oil on the machines.

In designing mining machines, space is always at a premium, and placing of hydraulic components is a problem. Therefore tanks generally are smaller than those used in industrial equipment. ▼▼▼

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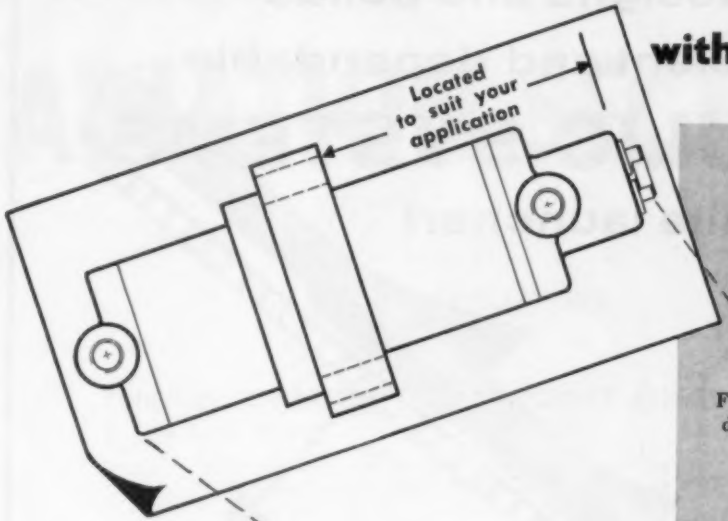
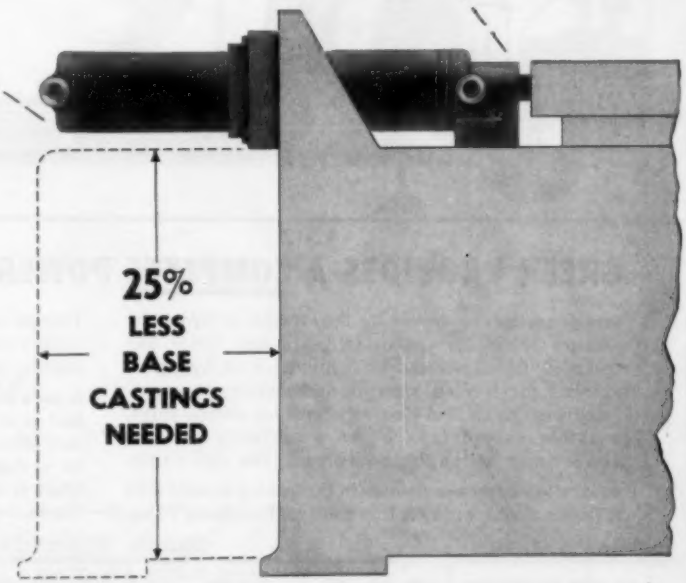
Pathon INTERMEDIATE FLANGE MOUNTING HYDRAULIC CYLINDERS



Application of the Pathon Intermediate Flange Mounting, as shown by the simplified drawing below, saved this machine company 25% of their base casting cost. Bonus advantages included reduced shipping weight, easier handling, and the universally recognized operating efficiency inherent in all Pathon Cylinders.

With Pathon Intermediate Flange Mounting Cylinders you choose whichever mounting position best suits your specific needs. Various heads of other mounting types may be combined with the intermediate flange to provide a large number of combination mountings. Thus special mounting brackets are eliminated. The cylinder is rotatable to any position for connecting pipe ports and mounting puds. Pathon Cylinders are available in the R. H. 2000 P.S.I. Series and the Q.H. 1000 P.S.I. Series.



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CIRCLE 72 ON PAGE 97

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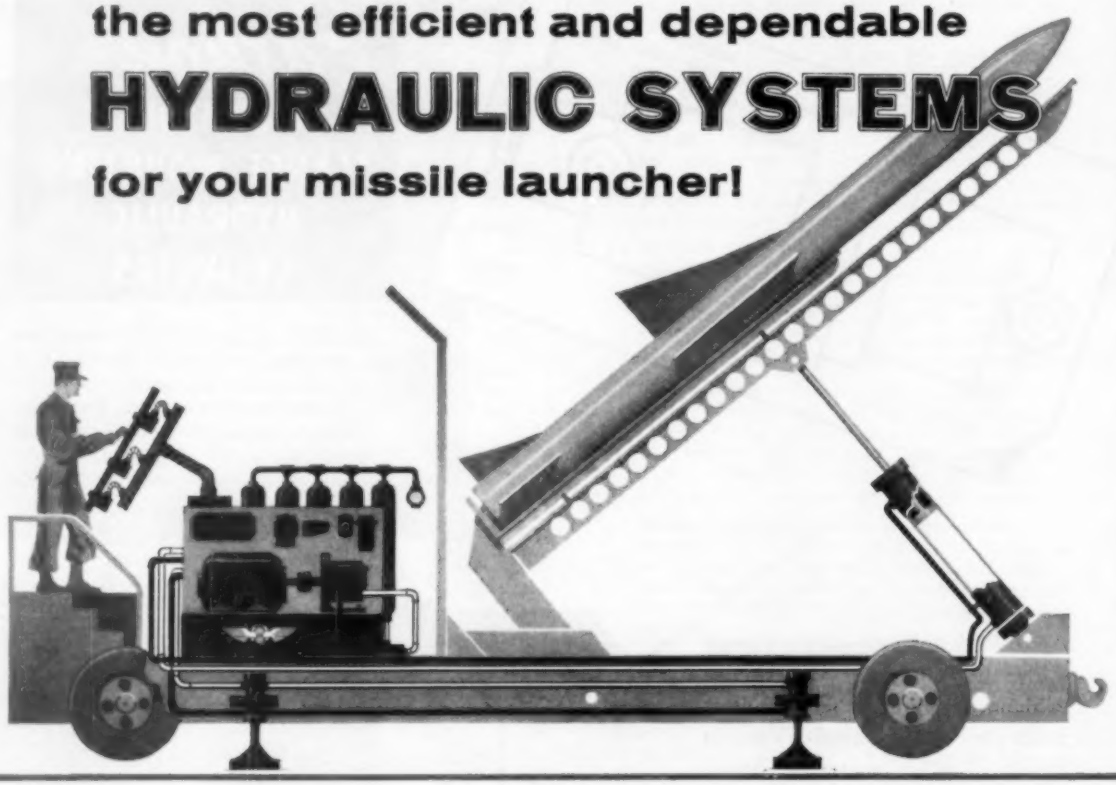

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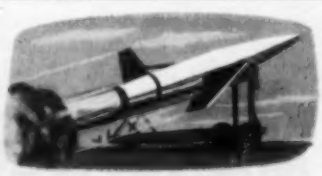
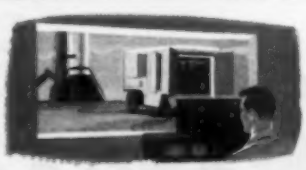


MISSILE LAUNCHING SYSTEMS



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CIRCLE 42 ON PAGE 97

AVIATION SECTION

Applied Hydraulics

FEBRUARY 1958

ORIFICES CONTROL SPEED IN AIRCRAFT ARRESTING GEAR 92

By R. G. Hoare

The aircraft hook which is extended to catch a cable strung across a carrier's deck must have shock absorbing action. This is accomplished by valving which is incorporated in the same housing with the hook actuator and piston accumulator.

SAE AIRCRAFT MEETINGS 96

Roundup of discussions at the Fall meeting in Miami Beach. Higher temperatures and pressures dominated the talks. A development pump for 700 F and a fluid tested to 700 F were among the main topics. Problems in developing 1000 F pneumatic and hydraulic systems were discussed.

AVIATION NEWS FROM THE FLUID POWER FIELD 102

AVIATION COMPONENT DATA 104

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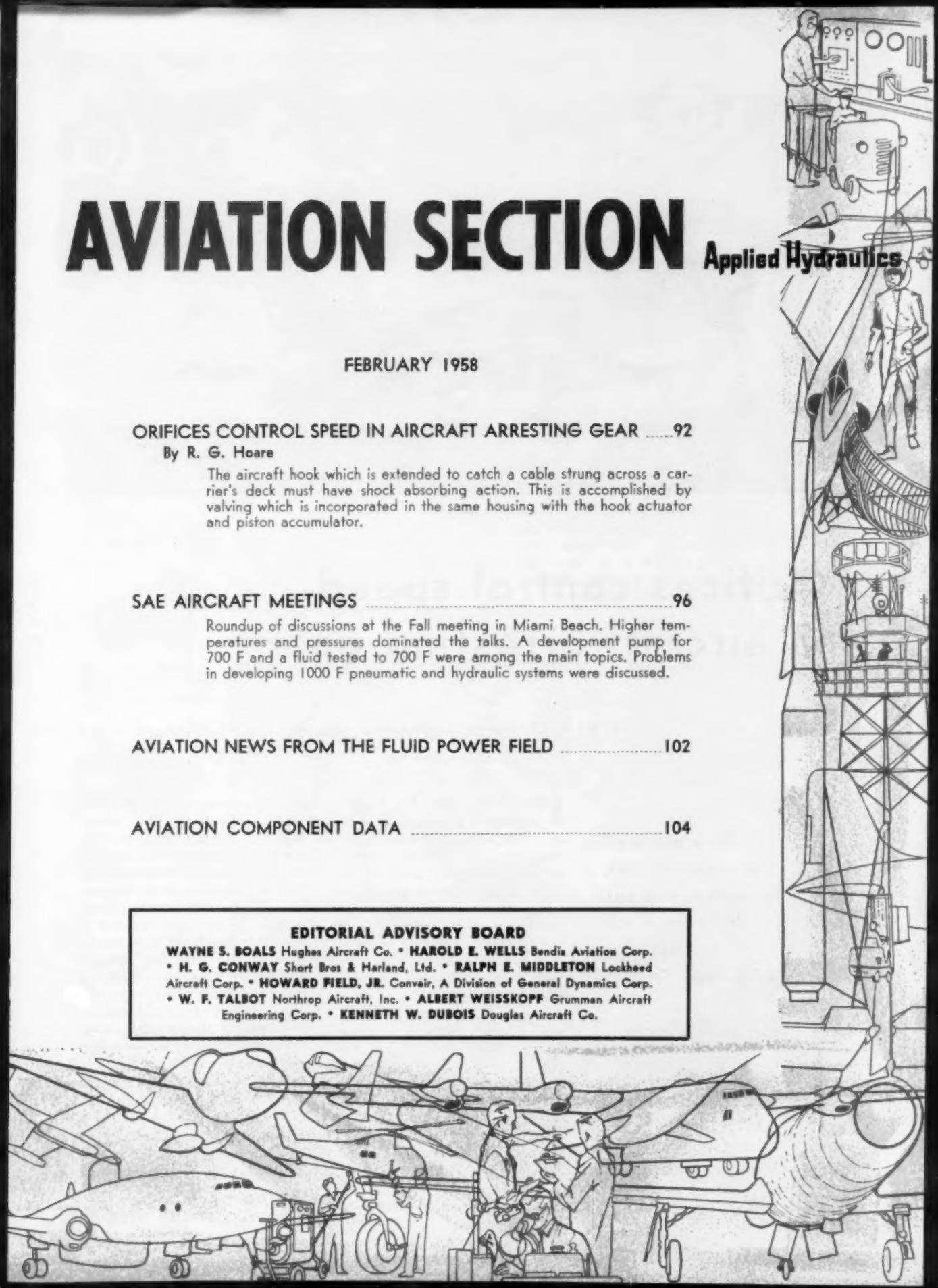

Orifices control speed in aircraft arresting gear

• By R. G. Hoare, *Chief Stressman, Electro-Hydraulic Ltd., Warrington, England*

When a pilot lands on a carrier's deck, he wants to stop fast. He lowers a hook to catch wires strung across the deck

ARRESTING gear for carrier landings is a number of wires or cables strung across the deck about 9 in. high. Wires are held by retractable posts and lead to shock absorbers which permit the wires to extend while absorbing the energy of the moving plane and gradually bringing it to a stop. A hook mounted on the aircraft must pick up one of these wires during landing.

One typical system for this service lowers the hook in about 6 sec, raises it in 1 sec, and has *skip* time of 0.15 sec. when it strikes the deck and re-extends.

• **System Operation**—Complete arresting system mounted on the aircraft consists of a cylinder, accumulator, a primary damping valve integral with the cylinder, an external secondary damping valve and a recuperator, Figure 1. All components of the system are combined in an assembly with the exception of the recuperator. To extend the arresting hook, port *Y* of the recuperator is opened to tank. This allows the accumulator to force fluid through orifices in the primary damping valve, open the check valve and extend the cylinder. Fluid from the rod side of the cylinder passes through orifices in the secondary damping valve and the recuperator to tank. Restriction offered by the various orifices is relatively low.

Recuperator piston moves to the left under accumulator pressure until the pin in the piston unseats

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ENGINEERS AND BUILDERS OF OIL HYDRAULIC EQUIPMENT SINCE 1921

the recuperator check, allowing fluid to pass to port *Y* and to tank.

Retraction is performed by applying pressure to port *Y* of the recuperator. Recuperator piston then moves to the right and fluid passes through its check valve and orifices of the secondary damping valve to the rod end of the main cylinder. Movement of the cylinder piston forces oil on the full-area side through small orifices in the cylinder check valve and connecting orifices to the accumulator. This forces the accumulator piston to the right and compresses the air in the accumulator. Flow rate and pressure during this portion of operation are not sufficient to unseat the relief valve portion of the damping valve.

DAMPING ACTION

Damping or shock absorbing system comes into play when the hook strikes the deck or hooks a cable. Port *Y* of the recuperator is blocked when the cylinder is extended, and accumulator pressure holds the cylinder extended. Contact with the cable or the deck tends to retract the cylinder. Sufficient pressure is generated to unseat the cylinder relief valve and allow fluid to pass through the orifices in the relief valve poppet. These orifices are dimensioned to maintain a constant pressure drop of 3000 psi across the relief valve for flow rates to 291 cu in. per sec. Damping ring on the poppet prevents hunting of the poppet.

Rapid piston movement when the hook hits the deck causes partial evacuation of the volume on the rod side of the piston because the system is not connected to any source of oil during this time. However, the recuperator serves as a limited source of oil under these conditions. Reduced pressure on the cylinder rod side permits the recuperator piston to be forced to the right by a 4000-psi supply pressure always applied to port *X*. This movement of the piston forces oil from the recuperator through the orifices in the secon-

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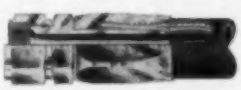
211—Medium pressure single wire braid hose. Temperature range: —40 to +275°F.



212—High pressure double wire braid hose. Temperature range: —40 to +200°F.

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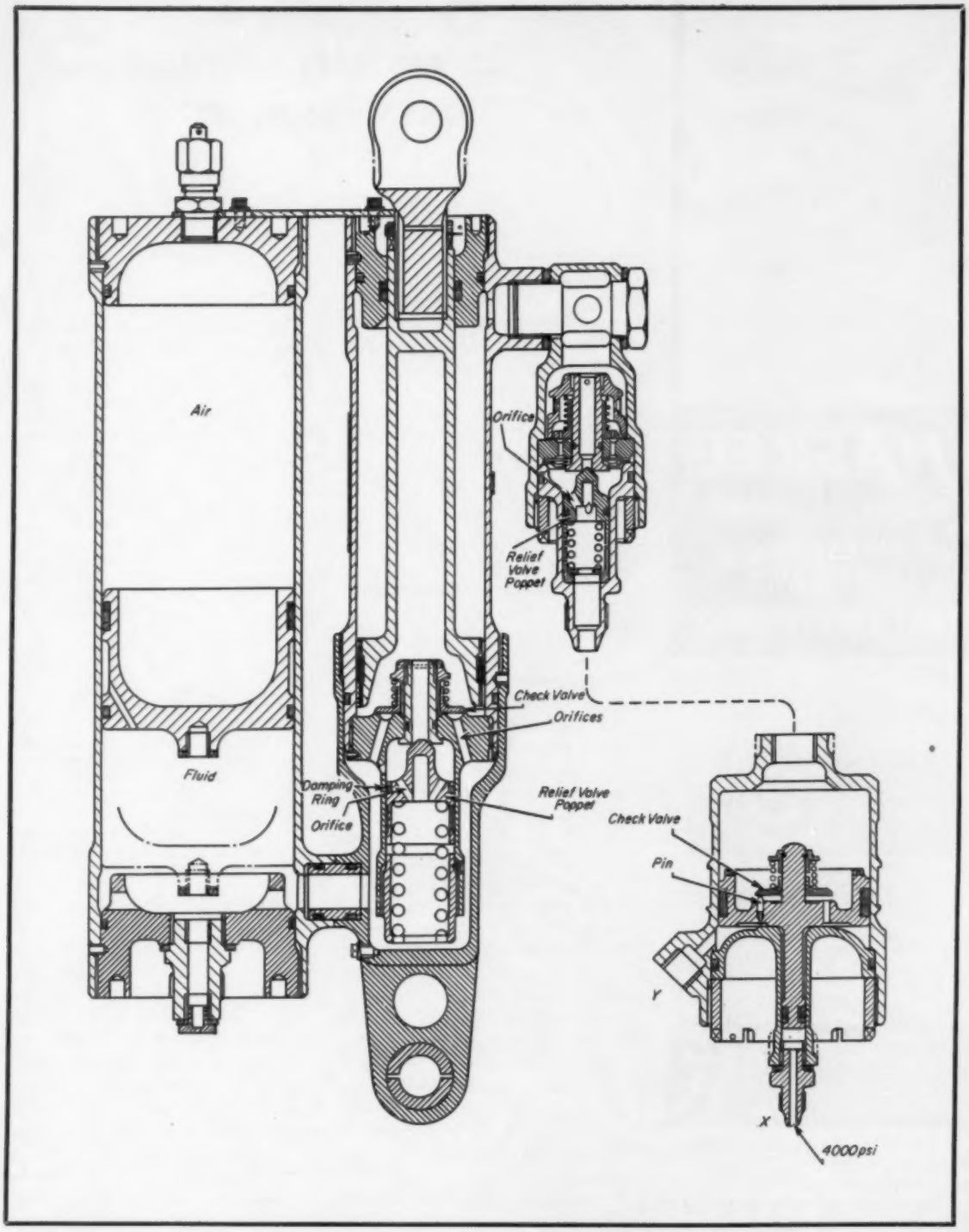

FIG. 1. Aircraft arresting gear hydraulic system. Extended length of cylinder is 20.25 in. between pin centers; stroke is 4.97 in. Maximum force exerted is 13,000 lb. Weight is 15.5 lb.

dary damping valve into the rod side of the cylinder. However, the rod side of the cylinder remains partially evacuated. This permits extremely rapid return of the piston to the *hook down* position by accumulator pressure and gravity until the piston encounters the charge of oil. Energy of the piston is then dissipated in forcing the oil through the orifices and relief valve in the secondary damper. Setting of the secondary damping valve relief poppet is 4000 psi. ▼▼▼

TE-3

COMPONENT TEST BENCH WITH AIR ACTUATED DOOR AND FLOWMETER TO MEASURE LEAKAGE. THREE REGULATED CIRCUITS WITH ADJUSTABLE RANGE FROM 0 TO 3600 PSI OPERATING FROM 5000 PSI NITROGEN SOURCE.

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SOME TERRITORIES OPEN FOR REPRESENTATIVES

CIRCLE 46 ON PAGE 97

Highlights of the SAE AIRCRAFT MEETINGS October 21-25, 1957

SAE aeronautical committees meet twice a year, spring and fall, to talk about problems (and solutions) in aircraft hydraulics and pneumatics. Component manufacturers, system designers, and aircraft users are represented. Solutions found satisfactory by all become the SAE and Military standards for aircraft hydraulic and pneumatic design.

PUMPS

Pumps that pass laboratory endurance tests often fail in service. Ralph Middleton (Lockheed-Burbank) and Charles Cannon (Lockheed Marietta) blame it on unrealistic laboratory tests that don't vibrate pumps the way an aircraft flight does. Hans Stern of GE said that vibration was only one of many things that may account for this. Contamination and fluid breakdown are two other things which lab tests don't allow for, he said. A panel was, therefore, formed to work out a better test.

In talking about their future needs, airframe people left the impression that reliability is more important than higher speeds and temperatures. However, there was general agreement that a pressure increase to 5000 psi has to come.

"Our high-temperature pump development," said a New York Air Brake man, "is running fine. We have a 400 F pump pretty well developed and a 700 F pump in the hardware stage under development." Vickers has a reliable 450 F pump in some sizes. Bendix, Denison and GE found encouragement in their tests of pumps for temperatures of 550 F and up.

Patch tests, according to Vickers, New York Air Brake, and Grumman, are fine for predicting pump reliability. Although, as George Keller (Autonetics) pointed out, patch testing is still an art rather than a science, Grumman reported a 70% increase in reliability with patch testing.

FITTINGS

T. S. Hale (North American) reported on these fitting tests:

1. In room temperature hydraulic tests, MS flareless fittings were best. That is, they withstood the greatest number of pressure cycles before failure. They failed at the ring cut. Flared fittings were found to fail at the flare.
2. In high-temperature pneumatic tests, AN fittings lasted five times longer than flareless types. Test sleeves were electroless nickle plated for the flareless fittings, since stainless steel sleeves will not seal under these conditions.
3. At —320 F, the average life of an AN fitting is close to double that of an MS flareless (618,766 cycles against 391,619).
4. High-temperature hydraulic tests. Aim was to see whether MS fittings would withstand 1830 cycles a minutes for 5 hours (a total of 549,000 cycles). Five flareless fittings stood up. One failed at 521,550 cycles. Two MS flared fittings passed; the other four failed at 13,725; 71,370; 57,645; and 296,460 cycles.

PNEUMATIC SERVO

Lockheed-Marietta is trying to build a 1000 F, 5000 psi pneumatic servo to actuate a dive brake. The design is far from complete, but Charles Cannon said, "Hard as it is to do, I think designing a pneumatic servo with consistent performance over the temperature range of 0 to 1000 F is easier than designing a hydraulic servo. Bulk modulus of air is nearly constant over this range, while bulk modulus of hydraulic fluid keeps decreasing."

Cannon went on to tell of the problems ahead. Tentative solutions have been found to some. For example, tubing and fittings have been made of Inconel-X. The power cylinder will be Inconel-X and Stellite. Several lubricants are being tested. Spool, flat-plate, cam, poppet and rotary valves have

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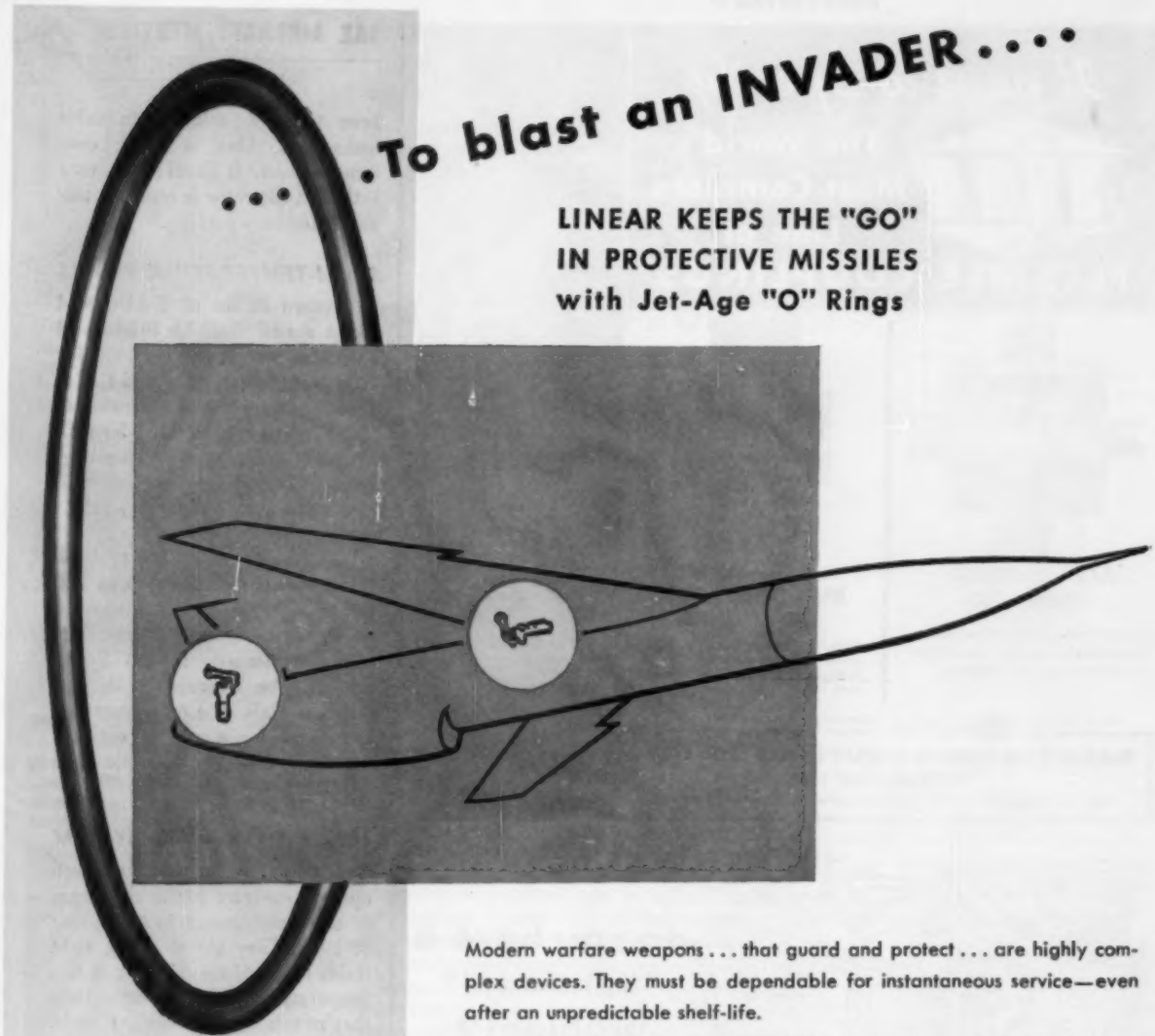
. . . To blast an INVADER . . . .

LINEAR KEEPS THE "GO" IN PROTECTIVE MISSILES with Jet-Age "O" Rings



Modern warfare weapons . . . that guard and protect . . . are highly complex devices. They must be dependable for instantaneous service—even after an unpredictable shelf-life.

In rocket and missile warfare use, "O" rings will be subjected to nitrogen, JP-4, ethylene oxide, hydrogen-peroxide, alcohol, liquid oxygen, fuming nitric acid, and other destructive environments. "O" rings are used in the servo-systems for flight control of guided missiles, and must withstand extremes in temperatures and the destructive actions of synthetic fluids.

LINEAR's experience in the design and production of precision "O" rings —of the most modern elastomers—has given them the ability to provide dependable seals for the most critical requirements.

When it's a sealing problem, call on LINEAR or one of its agents for engineering assistance . . .

and be sure to specify LINEAR "O" Rings for prototype or production.

"PERFECTION IN RUBBER"

LINEAR

LINEAR, Inc., STATE ROAD & LEVICK ST., PHILA. 35, PA.

CIRCLE 61 ON PAGE 97

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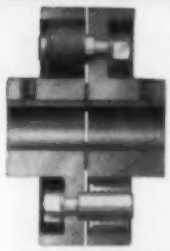
It pays to Specify

AJAX The World's Most Complete Line of FLEXIBLE COUPLINGS

AJAX DIHEDRAL COUPLINGS

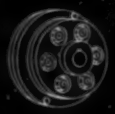
AJAX Patented Dihedral tooth shape handles angular and offset misalignment up to 12 degrees.



AJAX RUBBER-BRONZE CUSHIONED COUPLINGS

Safeguard your machines against costly shutdowns. Standard of industry for 37 years. All types and sizes.

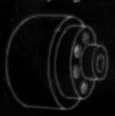
Ajax Type A Semi-Steel and Type S Forged Steel Couplings



Ajax Type SP Shear Pin Coupling

Ajax Type BO Bolt-On Coupling

Ajax Type M Mill Motor Coupling



Ajax Type BD Brake Drum Coupling

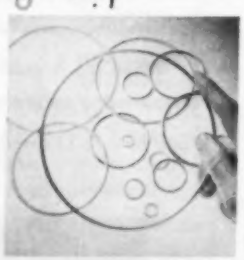
Write for Ajax Technical Catalogs. Representatives from coast to coast.

AJAX FLEXIBLE COUPLING CO. INC.
WESTFIELD, NEW YORK
Also manufacturers of Ajax vibrating conveyors, screens and packers.

do you have a "tight seal" problem?

Too many shrimp cocktails for this fella, but the circus will have him sober and back on the ball tomorrow. Here's a clear-headed suggestion, too, for tight seal problems involving metal-to-metal applications: buy United's Metallic O-Rings.

They fit any application calling for a positive, permanent seal against internal or vacuum pressures up to 10,000 p.s.i., in a temperature range from 70 to 1800°F. They are especially adaptable for sealing cylinder heads, air and hydraulic pressures, high octane fuels, vapors, gases, oils, solvents, chemicals, acids, vacuum and steam connections. Available in various metals and plating finishes, from ⅜" dia. to any size or configuration.



• free 22 page booklet describing United Metallic O-Rings, write (on your letterhead please) to Department L-2

UNITED METALLIC "O" RING CORP.
Dayton, Ohio • Box 1038
Division of United Aircraft Products, Inc.

SAE AIRCRAFT MEETING

AVIATION

been tried. A rotary-plate valve looks best. One is being constructed now. It should leak very little and the rotor is pressure balanced for easy turning.

HIGH-TEMPERATURE FLUIDS

Bernard Rubin of WADC told about a new fluid he thinks will work in an air-free system for long periods at —65 to 575 F. For short spurts, it might be run at 700 F. This fluid is GE F-50 with a special additive which improves its antiwear properties. The additive makes it as good as straight mineral oil and esters.

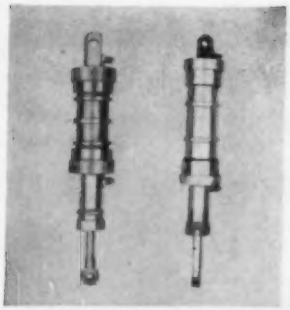
Test results show that silane fluids may be good for 0 to 700 F. Some of their shortcomings can be remedied with additives. For example, viscosity at 500 F can probably be improved with several materials. The experimenters, however, are not quite so optimistic about finding a simple cure for 700 F viscosity.

1000 F HYDRAULIC SYSTEM

Republic Aviation got a development contract for study stages of this development in the spring of 1957. They are studying eight fluids to see if they'll work at this temperature. At the same time they're testing materials and seals. Compatibility is also being evaluated. This phase of the work will end in May. ▼▼▼

FROM THE BLAZING INFERNO
OF AN AFTERBURNER
TO THE TORTUROUS VIBRATION
OF A MISSILE...

KIDDE COMPONENTS SOLVE YOUR PNEUMATICS PROBLEMS!

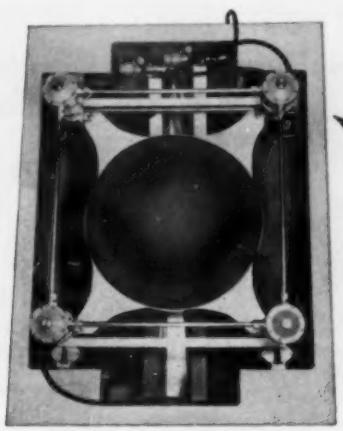


PNEUMATIC ACTUATORS: High pressure, for use in hot gas servo systems or in afterburner nozzle area control and thrust reverser controls.

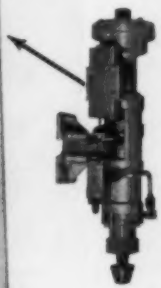
PRESSURE SWITCH: Controls cut-in and cut-out compressor pressures. Hermetically sealed, accurately maintains system pressure and serves as system pressure indicator.

CONTROL VALVE: 5000 psi, manual. Controls air flow to actuating components from supply source. Can be actuated directly by hand, cable pull, or other manual means.

METAL STORAGE CYLINDERS: 5000 psi—have moisture drain fittings which also provide connecting port between the cylinder and the rest of the pneumatic system.



Vibration Isolation System



Vibration Isolator

Newest Kidde development: The Pneumatic Vibration Isolation System. Employing relatively inexpensive components, it maintains desired low natural frequency and reduces the relative displacement at various load conditions.

The system shown above is one of several Kidde pneumatic vibration isolation system programs for protecting delicate missile control systems from undesirable vibratory disturbances and great transients in "g" loading which would affect accuracy of control. The component in the inset photo incorporates the system's mechanical and air snubbers, air spring, servo valve and passive isolator.

Research on projects like this new vibration isolation system goes on constantly in Kidde's vast creative pneumatics engineering department. For more information on any Kidde components, or help in solving specific pneumatics problems, write or call Kidde today.

Kidde

Walter Kidde & Company, Inc.
Aviation Division
216 Main Street, Belleville 9, N. J.

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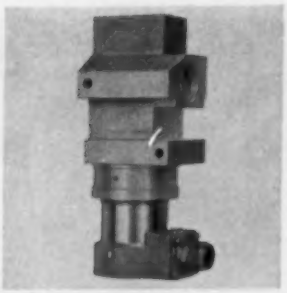
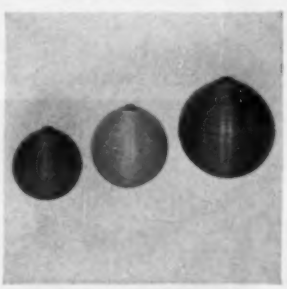
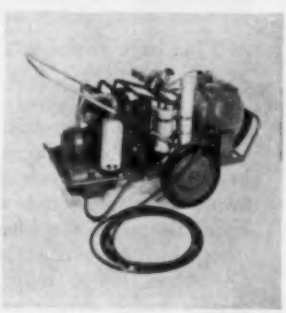


SOLENOID VALVE: New one-half inch pilot-operated valve. Extremely fast response time (25 milliseconds) for use in systems involving pulsating, high pressure gases.

QUICK DISCONNECT: Double-check — permits fast coupling or uncoupling of components without pressure loss. Has pressure check in both inlet and outlet unit.



FIBERGLASS SPHERES: Non-shatterable, 5000 psi. Feature very high strength-to-weight ratio. High impact resistance, excellent chemical immunity.



PORTABLE GROUND SERVICE CART: 4cfm compressor, drive unit, air driers and pneumatic storage sphere. Provide service at either 3000 or 5000 psi.

CIRCLE 58 ON PAGE 97

AVIATION NEWS

from the fluid power field

Dogan H. Arthur has been elected vice president-sales of **Titeflex Inc.,** Springfield, Mass. Formerly aircraft sales manager, Aeroquip Corp., Mr. Arthur is a graduate of the engineering school at the University of Michigan as well as a graduate of the Harvard Graduate Business School.

Dogan H. Arthur
Titeflex Inc.

William Patterson, Jr.
Aero Hydraulics Div.
Vickers Inc.

John W. Rowan
Vickers Inc.

New York—A device to check the efficiency of filters, separators, or dryers used with transparent high-pressure gases is sensitive to ½ micron particles if present in quantities larger than 100 parts per million. Designed and built by *Greer Hydraulics Inc.*, the detector is a photo comparator. Small particles in gas going through a sampling tube cross a sensitive photo-electric beam. If the particles are present in big enough quantities, they trigger an alarm mechanism. The unit will operate with gases at pressures to 10,000 psi.

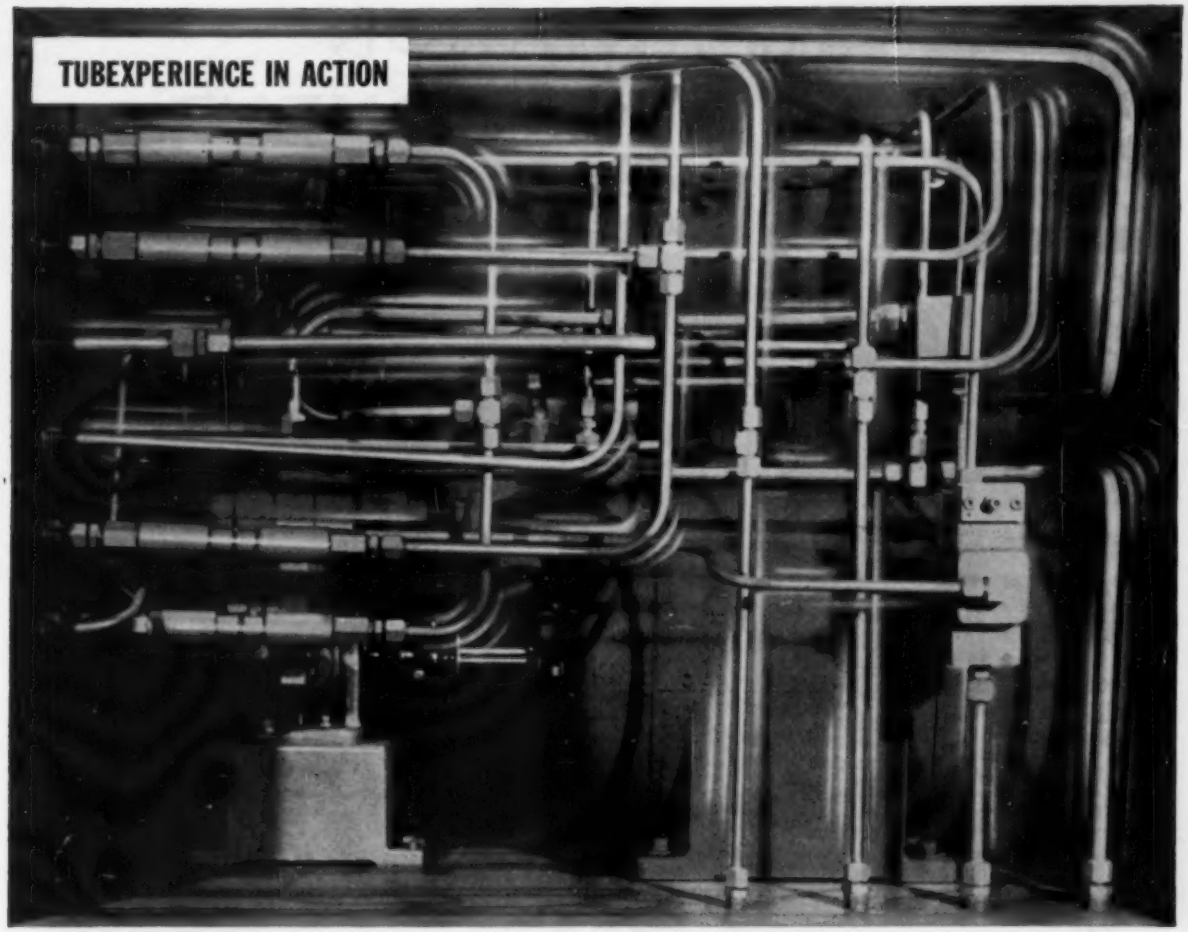
PROTOTYPE MODEL OF A GROUND SUPPORT VEHICLE . . .

. . . for large commercial jet and propjet aircraft was recently shown by *Consolidated Diesel Electric Corp.* The unit includes electric and pneumatic supplies to handle all aircraft ground requirements. Also, there is a source of hydraulic power for wheel mover units which are part of the system. The wheel mover units are hydraulic motor driven and attach quickly to the main wheels of the aircraft to drive it on the ground. The tongue on the front of the ground vehicle attaches to the nose wheel. The aircraft pilot can then steer both aircraft and the attached truck with a small remote control set. Speeds to 5 mph can be reached. Primary advantage of this system is that it uses the weight of the aircraft to obtain the necessary tractive force. Production model of this vehicle will gross approximately 6000 lb. One large enough to actually tow the aircraft would have to be much larger.

Wyle Associates has been joined by four new technical liaison engineers, to provide service in missile and aircraft industry centers throughout the country.

Creation of the new position of Preliminary Design Engineer for the Aero Hydraulics Div. has been announced by **Vickers Inc. William Patterson, Jr.** has been named to the new position. Purpose of the new post is to provide additional engineering support by setting up a centralized source of engineering proposals for new products, new systems and new subsystems as well as the adaptation of existing products and systems to new needs.

John W. Rowan has been made Service Manager, Detroit Aero Hydraulics Service Section, **Vickers Inc.** Mr. Rowan will be responsible for product improvement, field service, unit repair and overhaul activities in the area east of the Rocky Mountains.



VIBRATION can murder hydraulic lines

Only tubing with high ductility and smooth, uniform surfaces can take this terrific punishment in its stride!

When big motors start delivering power, hydraulic lines go into their vibrating dance. Unless the lines are made from highly ductile material and have exceptionally smooth, uniform surfaces, the ceaseless, pounding vibration may actually cause cracks and ruptures.

Superior hydraulic tubing is available through leading warehouse distributors from coast to coast. Contact the one nearest you today for information—or get a free copy of Bulletin 39 by writing to Superior Tube Company, 2030 Germantown Ave., Norristown, Pa.

HERE'S WHY SUPERIOR (SAE) HYDRAULIC TUBING WILL GIVE YOU LONGER, MORE ECONOMICAL SERVICE

High ductility! *Furnished in dead-soft annealed temper, Superior hydraulic tubing flares easily, bends without pinching, can be readily fabricated for any hydraulic application.*

Non-aging steel! *All Superior hydraulic tubing is made of selected non-aging steel. It keeps its ductility, will not become brittle with age. Carbon content is limited to .12% maximum.*

Bright, smooth, clean! *Special processing gives Superior hydraulic tubing an unusually bright, smooth, clean finish on both OD and ID; reduces turbulence and pressure drop. Shipped with special rust preventive coating on both inside and outside surfaces.*

Fully tested! *And not mere random sample testing! Every length of Superior (SAE) hydraulic tubing is 100% hydrostatically tested at maximum working pressure—giving you realistic performance insurance.*

Superior Tube

The big name in small tubing

NORRISTOWN, PA.

All analyses .010 in. to ⅜ in. OD—certain analyses in light walls up to 2½ in. OD

West Coast: Pacific Tube Co., 5710 Smithway St., Los Angeles 22, Calif. • RAymond 3-1331

CIRCLE 97 ON PAGE 97

CIRCLE 1 ON PAGE 97

only the **Fall** Gets it All!

CLOSED JOINT

WHY be satisfied with only partial removal of dirt or other foreign accumulation from piston rods when you can—

Remove ALL the Dirt from Rod O.D. Stop Dirt Passing Through the Ring Joint with a

Fall **"CJ" WIPER RING**

The Ring with a Closed Joint!
SPRING LOADED
with Squeeze Grip Action

If you have a wiper ring problem write, wire or phone us.
All Fall Rings are covered by patents issued or patents pending.

ACE PRODUCTS CO.,
Toledo 1, Ohio
Phone Cherry 3-6513
You Can Depend on ACE Products—Established 1885

IMMEDIATE DELIVERY

contour cutters for popular hydraulic ports!

One pass completes all operations necessary to produce the port contour. Job time cut as much as ⅔! All have carbide cutting edges for long life, smooth finishes. Available in all sizes. Write for prices.

SONNET
Tool and Mfg. Co.
576 North
Prairie Avenue
Hawthorne
California

CIRCLE 93 ON PAGE 97

AVIATION COMPONENT DATA

Flow Limiters
. . . have high accuracy

A contoured variable orifice makes these flow limiters accurate to almost ±1%. Valves are for

pressures to 5000 psi; flow rates from 0.5 to 11 gpm. Smaller or larger sizes can be quickly produced to order. Operating temperature range is —65 to 400 F. A plunger and a spring are the only moving parts.—*Conair Inc., Glendale, Calif.*

CIRCLE 500 ON PAGE 97

Motor-Pump
. . . for aircraft and missiles

Unit consists of a pump rated at 0.059 gpm at 1000 psi with 30 v applied to the dc motor. Permanent magnet motor has a radio noise filter. Emergency duty rating is 0.015 gpm at 1600 psi. Designed

for intermittent duty, the pump will deliver 0.025 gpm at 100 psi at 18 v dc. Current drain over the 18 to 30 v range is 3.25 amp. Ratings are for MIL-O-5606 fluid. Operating temperature is from —65 to 255 F with this fluid. Volumetric efficiency of the pump is 95%.—*Lear-Romec Div., Lear Inc., Elyria, Ohio.*

CIRCLE 501 ON PAGE 97

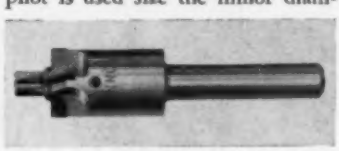
Time Delay Relays

. . . for aircraft, missile and rocket applications are covered by Bulletin AWH-TD-502. Charts on time delay tolerances, approximate weights, wiring diagram, outline and mounting dimensions are in the bulletin. Basic military specifications which the units meet are also tabulated.—*A. W. Haydon Co., Waterbury, Conn.*

CIRCLE 502 ON PAGE 97

Port Cutter
. . . for steels

A line of heavy-duty AND 10050 port cutters for steels, including stainless, produce the contour in a single pass and when a reamer pilot is used size the minor diam-



eter of the Class 3 threads. The cutters may also be used with nonferrous materials. Cutting edges are tipped with tungsten carbide for long life. Thirteen diameters from ⅛ through 2 in. are made.—*Sonnet Tool & Mfg. Co., Hawthorne, Calif.*

CIRCLE 503 ON PAGE 97

Ultra-Strength Steels

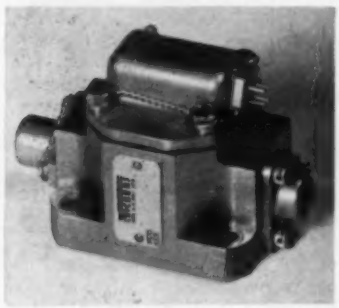
. . . with yield strengths over 200,000 psi are described in a new 16-page booklet. Technical data on composition, properties and applications are included.—*Climax Molybdenum Co., New York, N. Y.*

CIRCLE 504 ON PAGE 97

Dry Coil Servo Valve
. . . is light, compact

Designed primarily for aircraft and missile applications this servo valve is 20% lighter and more compact than others of similar capacity. Dry coil is unaffected by magnetic

particles in the hydraulic fluid. First stage—torque motor, flapper, jets and barrier—is packaged. This simplifies field service and lets different second stage components be used. Jet position is adjustable while the valve is operating. This lets static flow gain be accurately



set. Air gaps are self cleaning. Multiple filters are built in.

Torque motor is a polarized relay type with rated differential current of 8 ma. Rated flows are 2.5 or 5 gpm. Both models measure 3.08 by 1.75 by 1.83 in. Weight is 9.3 Oz. Pressure rating is 3000 psi. Temperature range is —65 to 275 F.—*Vickers Inc., Detroit, Mich.*

CIRCLE 505 ON PAGE 97

Service & Test Equipment

. . . for all types of aircraft maintenance work are covered in a 14-page illustrated bulletin. Units described include component test stands and benches, and portable equipment such as cabin leakage testers, jet engine starters and ground air power units. Bulletin No. 253.—*Sprague Engineering Corp., Gardena, Calif.*

CIRCLE 506 ON PAGE 97

Compact Valve . . . has high flow rate

Normally-closed, solenoid-opened valve has flow rating of valves

twice its size. Pilot-operated, the valve may be used at pressures of 300 psi or more. Internal leakage is very low.—*Eckel Valve Co., San Fernando, Calif.*

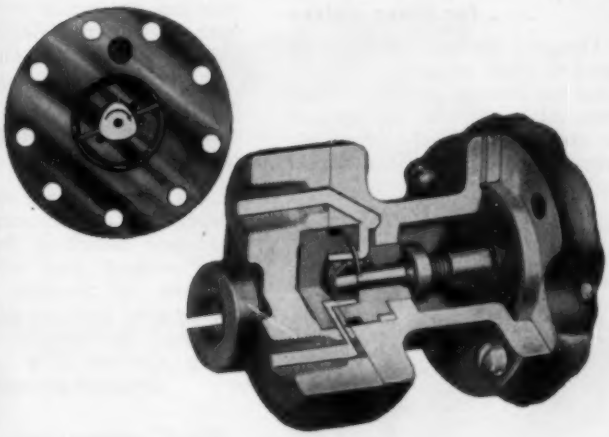
CIRCLE 507 ON PAGE 97

Continued on next page

WELDON

FLUID METERING PUMPS

Positive Displacement Rotor Type. For Industrial Applications, Aircraft Anti-Icing and Aircraft Fuel.



IT'S SO SIMPLE!

The rotation of the rotor draws the fluid in through two passages, filling the cavities formed by the three lobes of the rotor. This fluid is sealed within these small cavities until it is forced through the two outlet holes by the floating blades. The flow may be kept uniformly divided through two outlet ports, or may be combined internally for passage through a single port.

Compact • Light Weight

Send for Weldon Manual and Catalog with detailed specifications and installation drawings, covering the full range of Weldon pumps in various capacities. Specify your requirements.

THE WELDON TOOL COMPANY

3000 WOODHILL ROAD · · · CLEVELAND 4, OHIO

CIRCLE 117 ON PAGE 97

AVIATION COMPONENT DATA

Compact Test Stand
. . . for servo valves

Designed for easy operation by semi-skilled operators, this test stand has controls grouped at hand level. All instruments are grouped at correct eye level. Removable doors on all sides of the cabinet make access easy.

Floor space of only 8 by 3 ft is needed. Stand uses 440 v ac; will deliver up to 15 gpm of MIL-O-5606 at pressure to 6000 psi; has filter system good for 0.3 mg/100 cc, and has automatic fluid temperature control.

One switch selects all tests such as insulation breakdown, coil resistance, etc. An X-Y plotter automatically plots curves of flow vs. current, pressure vs. centering current and differential cylinder pressure vs. current.—*Gladden Products Corp., Glendale, Calif.*

CIRCLE 508 ON PAGE 97

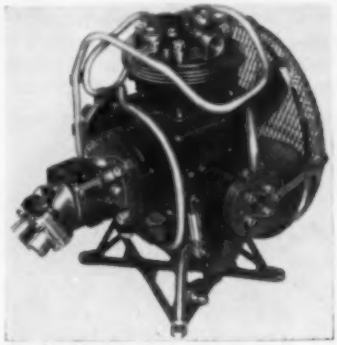
Aircraft Plumbing Handbook

. . . is hardbound and contains 64-pages of data on fluorocarbon hose and hose assemblies. In addition, the handbook gives working suggestions on plumbing runs, discusses good mock-up practices and suggests applications.—*Resistoflex Corp., Roseland, N. J.*

CIRCLE 509 ON PAGE 97

Air Compressor
. . . is versatile

MC 2004 compressor is designed for missile and aircraft use and can also be used in ground support applications. Unit may be driven by hydraulic motor, ac or dc electric motor, or may be pad-mounted and engine-driven. Four-stage, piston-type, it has anti-friction bearings,



weighs 11.87 lb, and has rated capacity at sea level of 2 scfm at 3000 psi outlet pressure.—*M. C. Mfg. Co., Lake Orion, Mich.*

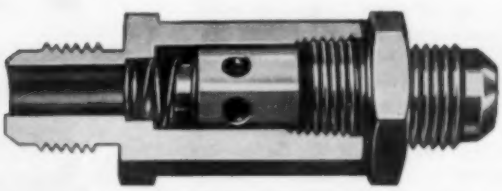
CIRCLE 510 ON PAGE 97

Piston Pumps

. . . of the constant-displacement type, intended for airborne service, are discussed in Bulletin A-5206-B. Size, weight, operating speeds, theoretical flow rates and general descriptive material are included. —*Vickers Inc., Detroit, Mich.*

CIRCLE 511 ON PAGE 97

KOHLER
PRECISION CONTROLS



Powerful Rocketdyne liquid propellant engines for the "Atlas", "Thor", "Jupiter", "Redstone" and other mighty missiles for America's defense—are served by Kohler check valve K-1359.

This 3000PSI soft seat type valve can be supplied with any type of connection. The "O" ring, held in place by a specially designed retainer, cannot be washed out of position by high surge pressure.

Kohler Precision Controls include a full line of valves for control of hydraulic, gasoline, lubricating oil, water, chemical, air and vacuum lines.

Our engineers develop valves and fittings to specifications for volume production. Write for information.

Static test stand where power developed by rocket propulsion engine is measured.

KOHLER CO. Established 1873 KOHLER, WIS.

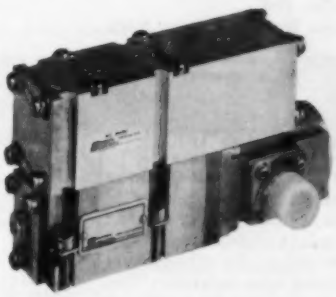
KOHLER OF KOHLER

Enameled Iron and Vitreous China Plumbing Fixtures • Brass Fittings • Electric Plants • Air-cooled Engines • Precision Controls

Now...from a single source...

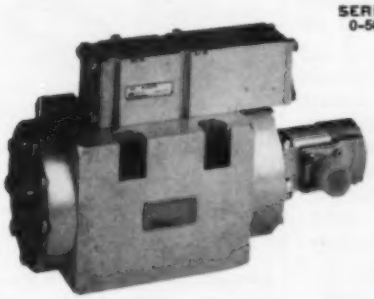
THE FIRST COMPLETE LINE OF ELECTRO-HYDRAULIC SERVO VALVES

SERIES 100
0-5 gpm

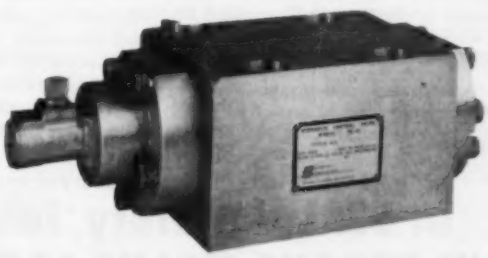


SERIES 200
0-10 gpm

SERIES 300
0-50 gpm



SERIES 500
0-200 gpm



Sanders BOOTSTRAP(T) *Servo Valves for all industrial, marine and aircraft applications*

Sanders Electro-Hydraulic Servo Valves are based on the reliability-proved "BOOTSTRAP" two stage internal force feedback principal. This design converts low input into powerful thrusts, while providing high internal stiffness of control.

These valves have high frequency response, high resolution and low threshold. Large-area internal pilot stage filters plus large orifices and nozzles add up to extra reliability. Manifold mounting allows flexibility in external connections.

Sanders' extensive application experience is at your service in solving servo valve and hydraulic system problems. Extensive manufacturing facilities assure fast, economical production. For complete details about specifications, prices and delivery schedules, write:

TYPICAL SPECIFICATIONS

	SERIES 100	SERIES 200	SERIES 300	SERIES 500
Flow Range (GPM at 1000 psi ΔP)	0-5	0-10	0-50	0-200
Supply Pressure (psi)	200-3000	200-5000	200-3000	500-3000
Overall Size (inches)	2¼ x 2¼ x 2½	5¾ x 1½ x 3	8⅜ x 3¼ x 5⅛	15¼ x 6½ x 4¾
Approximate Weight (pounds)	1.0	3.6	7.5	35.0
Nominal Input Power (watts)	0.1	0.2	1.0	1.0
Coil Resistance (ohms /coil)	100-3000	100-3000	100-3000	100-3000
Amplitude Ratio	–3db at 150 cps	–3db at 80 cps	–3db at 60 cps	–3db at 30 cps
Phase Lag	90° at 150 cps	90° at 80 cps	90° at 60 cps	90° at 30 cps

(T) TRADEMARK—SANDERS ASSOCIATES, INC.

SANDERS ASSOCIATES, INC.

DEPT. B, NASHUA 2, NEW HAMPSHIRE • *Inglewood, California* • *Washington, D.C.*

CIRCLE 119 ON PAGE 97

CIRCLE 2 ON PAGE 97

Aftercooler and Cyclone Separator designed for cleaner, dryer compressed air

R. P. ADAMS CO., INC.
249 East Park Drive, Buffalo 17, New York

The Adams Aftercooler and Cyclone Separator are designed to efficiently condense and remove water from compressed air and process gas. Condensed moisture and entrained dirt and oil are subsequently removed in a cyclone type separator. This unit is scientifically designed for maximum removal efficiency over a wide range of flow rates.

For normal use, units are available to cool gases to within 10° F of the temperature of the cooling water. Specially designed units are available to permit a 2° F approach to cooling water temperature, for application where low moisture content is critical.

Adams Aftercoolers and Separators are available from stock to handle 20 - 40,000 cfm with 10° cooling and 25 - 19,200 cfm where it is necessary to cool within 2°F of the cooling water. Special units can be supplied to suit an unlimited range of requirements. In all cases the maximum pressure loss at rated capacities is ½ psi.

This wide range of sizes enables the economical utilization of Adams Aftercoolers and Separators in virtually all industrial application. For further information on how R. P. Adams' units will solve your compressed air problems and save you money, write today for Bulletin 711.

In SEALOL Rotary Joints... LOW TORQUE MEANS LONGER LIFE!

The balancing of pressures acting on the working parts of Sealol Rotary Joints is a *totally new concept* which reduces friction to an absolute minimum . . . translated into user benefits, this means maximum performance, longer life, and minimum maintenance. Compare the outstanding performance of Sealol Rotary Joints, and see how they compare with other rotary joints on the market.

Remember that when you're talking TORQUE, you're talking money . . . *your* money! When it's LOW TORQUE you want in your rotary joints, you're talking SEALOL. Request Bulletin 14 and get complete data on these leak-proof, low torque, long-lived Sealol Rotary Joints . . . whose balanced-pressure design works equally well on vapor, liquid, or gas applications.

SEALOL

SEALOL CORP
152 Post Road, Providence 5, R. I.

NEW PRODUCTS

SOLENOID VALVES
. . . feature unique plunger seal

Designation: SV-4900 Series

Features: Valves are 2-way, normally closed, have stainless steel internal construction and brass body, are small and light. A unique

plunger seal design with a soft rubber seal assures bubble-tight sealing.

Specifications: Units measure 2.35″ high by 1.5″ wide. 7/64 orifice—130 psi; 5/32 orifice—60 psi.

Application: Designed for general usage with water, air, steam, inert gases, petroleum and vegetable oils, gasoline, kerosene and other semi-corrosive media.

Valcor Engineering Corp.
Kenilworth, N. J.

CIRCLE 307 ON PAGE 97

AUTOMATIC-RETURN AIR CYLINDERS
. . . have built-in control valves

Designation: Type AV

Features: Cylinders are available for single control either by electric switch or bleeder valve and come with rods either normally retracted or extended. Separate return-controlling units previously mounted outside of the cylinders have been designed as an integral part of the cylinder heads. Available for either

Continued on page 110

CIRCLE 86 ON PAGE 97

NEW HYDRAULIC TORQUE AMPLIFIER ANSWERS MANY BOOSTER AND CONTROL PROBLEMS

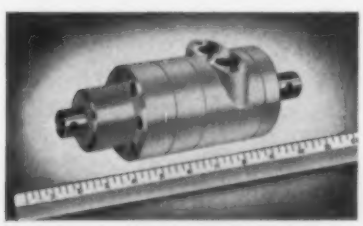
INGENIOUS GEROTOR USE DEVELOPS HIGH TORQUE LOW SPEED UNIT

By a unique use of the basic mechanism known as the Gerotor, Char-Lynn has developed an amplifier that produces many times the torque normally expected from a unit of its size.

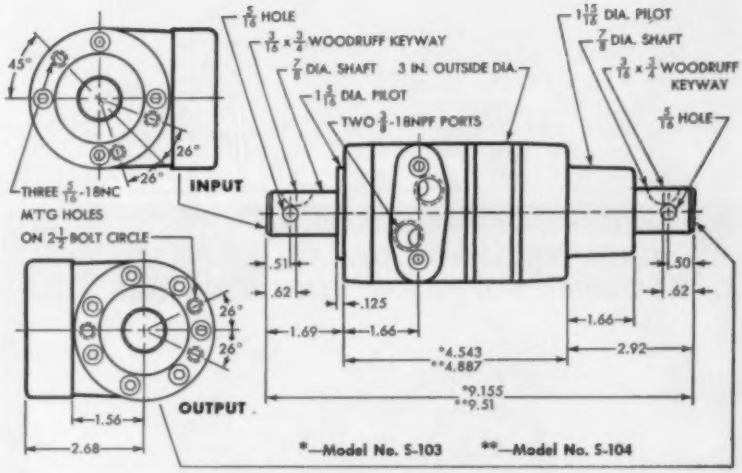
When the Gerotor is in ordinary use, both the inner and outer rings revolve about their own fixed centers, each at a different speed.

However, the NEW patented operating principal used in the hydraulic motor of the Char-Lynn amplifier differs from the usual application, in that the outer ring is held STATIONARY, and the rotor rolls around the ring on a center which describes a circle. With this construction, the Gerotor becomes both a fluid displacement mechanism and a gear reduction. For example . . . a six to one speed reduction is obtained by using a seven-tooth ring and six-tooth rotor.

This design makes it possible to use the Gerotor mechanism to develop VERY HIGH TORQUE at LOW OUTPUT SHAFT SPEEDS. The output shaft duplicates the movement of the input shaft regardless of direction of the rotation . . . and is NOT LIMITED TO PART OF A REVOLUTION or a FEW REVOLUTIONS, but will operate in CONTINUOUS ROTATION at speeds up to SEVERAL HUNDRED revolutions per minute.



ONLY 3" IN DIAMETER, 9" IN LENGTH, this small compact unit will simplify many design problems where space is limited. It's total weight of only 8 lbs., also answers weight or shaft load problems.



Char-Lynn's new Hydraulic Torque Booster offers something entirely different in the field of hydraulic controls. The unit already has found wide acceptance in a practically unlimited field where a rotary control or power shaft requires a power boost.

APPLICATIONS

- Power Steering for vehicles, aircraft, boats.
- Automation applications.
- Electronic controls where small input signal may control a large output.
- Provides control for printing presses, large photographic and X-Ray machines.
- Controls on atomic reactors and "hot" handling equipment.
- Power drive for feed screws and spindles.
- Actuate and afford smooth control for heavy construction equipment, rolling mills, puddling equipment, milling and grinding controls, heavy gate controls.
- Actuate large valves.
- Power boost for control surfaces on aircraft and missles.
- Control heavy loads at remote points.

IN SHORT

ANY ROTARY CONTROL OR POWER SHAFT WHICH REQUIRES A POWER BOOST CAN EASILY BE ADAPTED TO UTILIZE THE CHAR-LYNN UNIT.

SPECIFICATIONS		
	IS-103	IS-104
TORQUE OUTPUT	615 inch lbs.	1100 inch lbs.
RATED OPERATING PRESSURE	1000 psi	1000 psi
OPERATING SPEED RPM at 3 gpm	99	69
RECOMMENDED FLUID SUPPLY	2.5 to 3 gpm	3 to 4 gpm

IS-103 A High Speed unit, making available an output torque of 615 inch pounds at 1000 psi. The unit requires a fluid supply of 3 gpm for a speed of approximately 100 rpm. Port block to provide ⅜ NP connection. O-rings and cap screws furnished.

IS-104 A High Torque unit, making available an output torque of 1100 inch pounds at 1000 psi. A fluid supply of 3½ gpm is recommended, giving a speed of approximately 80 rpm. Port block to provide ⅜ NP connections, O-rings and cap screws furnished.

For further details and engineering assistance, call or wire—Char-Lynn Company—PA 9-2354—Minneapolis . . . or fill in coupon below.

NAME_____

POSITION_____

FIRM_____

ADDRESS_____

CHAR-LYNN COMPANY
Dept. A82, 2843-28th Avenue So.
Minneapolis 6, Minn.

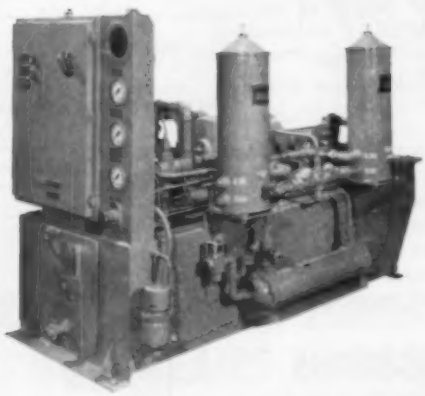
CIRCLE 21 ON PAGE 97

NEW PRODUCTS

8, 110 or 220 volt operation. All models come in 1½, 2, 3 and 4 inch bore sizes. Automatically reciprocating models require only one air connection to the cylinder-valve unit and are controlled by a standard shut-off valve.

A. K. Allen Co.
Mineola, N. Y.
CIRCLE 308 ON PAGE 97

CARDWELL GUN DRILL COOLANT SUPPLY SYSTEM



Specially designed for deep hole drilling and trepanning. High pressure coolant 1000 PSI to 40 GPM in 3 different standard size units. 10, 20 and 40 GPM. Coolant filtered down to 5 MU continuously.
Write for price list and descriptive literature.

The CARDWELL MACHINE COMPANY
Franklin at 19th St., Richmond 11, Va. • Phone MIlton 4-4593

CONTROL VALVES

. . . resist corrosion

Application: Units are designed for control of rubber molding and similar equipment.

Features: Valves are diaphragm-operated and have ductile iron bodies for use with high pressure, high temperature hot water. More corrosion-resistance than steel is claimed for the ductile iron and

it is said to have a tensile strength three times that of bronze. Hardened stainless steel stem and replaceable seat inserts are used.

Specifications: Suitable for hot water service at pressures up to 600 psi and temperatures up to 350 degrees F.

Sinclair-Collins Valve Co.
Akron, Ohio
CIRCLE 309 ON PAGE 97

LUBRICATORS

. . . eliminates manual filling

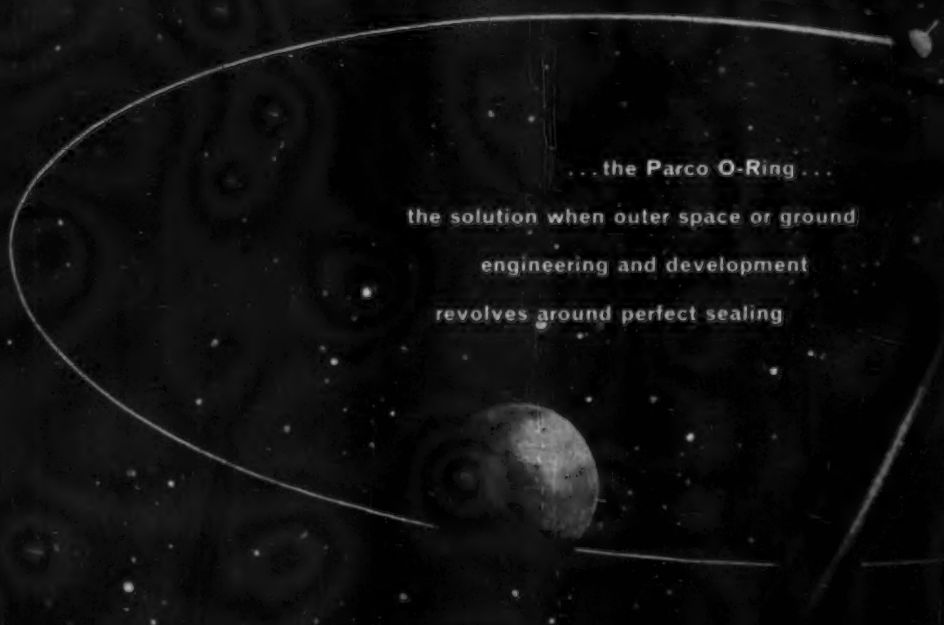
Designation: Auto-Fill

Features: The system does away with manually filling lubricators on numerous air powered tools. An unlimited number of lubricators receive oil from the same sup-

Continued on page 112

CIRCLE 19 ON PAGE 97
CIRCLE 74 ON PAGE 97

ORBIT OF INDUSTRY



. . . the Parco O-Ring . . .

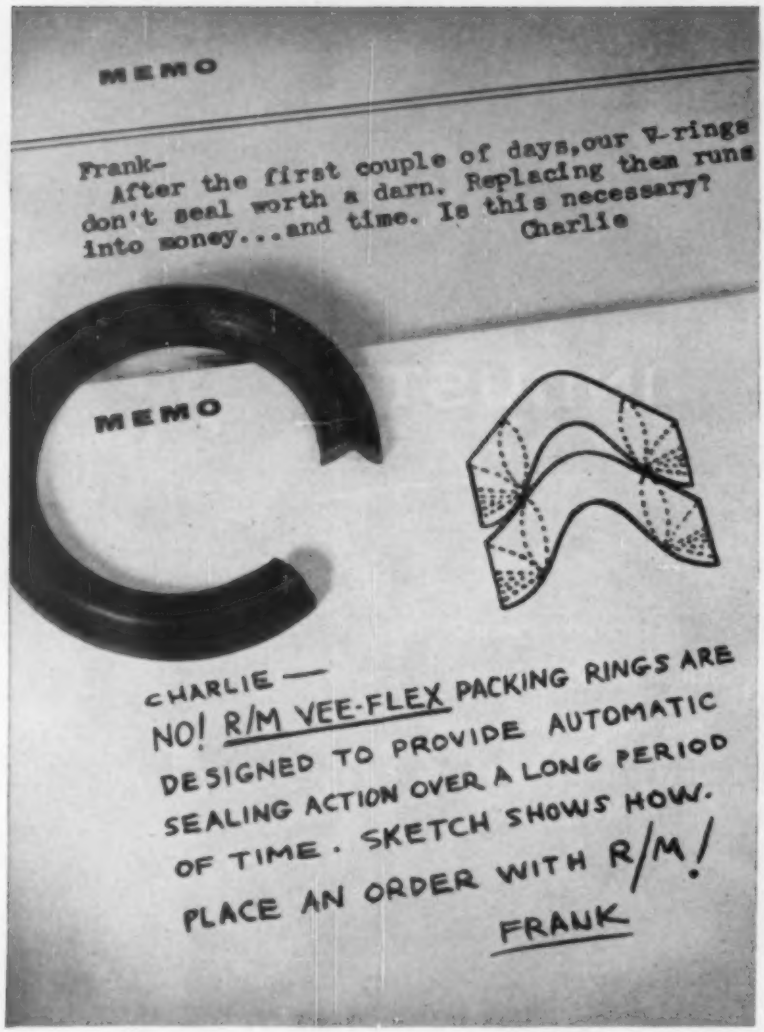
the solution when outer space or ground

engineering and development

revolves around perfect sealing

Perfect sealing demands the exceptionally high efficiency found in Parco O-Rings, enabling successful operations for the simplest or most complex engineering designs. Parco dependability and know-how in rubber technology assures the proper seals for the most exacting tolerances. There is a Parco engineering representative conveniently located in your area to help you solve your design problems. Consult your local 'phone book or write us direct. Ask for technical data reference log 1581 available free upon written request to

PARCO Plastic and Rubber Products Company 2100 Hyde Park Boulevard, Los Angeles 47, California


MEMO
Frank–
After the first couple of days, our V-rings don't seal worth a darn. Replacing them runs into money...and time. Is this necessary?
Charlie
MEMO
CHARLIE —
NO! R/M VEE-FLEX PACKING RINGS ARE DESIGNED TO PROVIDE AUTOMATIC SEALING ACTION OVER A LONG PERIOD OF TIME. SKETCH SHOWS HOW.
PLACE AN ORDER WITH R/M!
FRANK

Ordinary V-rings, with their flat surfaces, provide little or no automatic sealing action against the walls of the cylinder, with the result they quickly lose effectiveness. This means, of course, loss of power and eventually a maintenance problem. R/M Vee-Flex Packing Rings are specially designed to solve it for you. Convexly curved surfaces where the rings meet and thinner cross section at the apex of each V cause a flexing action which makes a firm seal on the shaft and stuffing box wall and between rings.

R/M Vee-Flex Rings are available in many compositions to meet the hazards of various applications: high temperatures, high pressures, fast cycling, corrosion, or combinations of these.

R/M's engineers have amassed a wealth of experience in manufacturing packings and gasket materials to meet the most exacting requirements of industry. This experience is at your disposal—call on R/M.

R/M **PACKINGS**
RAYBESTOS-MANHATTAN, INC.
PACKING DIVISION, PASSAIC, N.J.
MECHANICAL PACKINGS AND GASKET MATERIALS

RAYBESTOS-MANHATTAN, INC., Mechanical Packings • Asbestos Textiles • Industrial Rubber • Engineered Plastics
Sintered Metal Products • Abrasive and Diamond Wheels • Rubber Covered Equipment • Brake Linings
Brake Blocks • Clutch Facings • Industrial Adhesives • Laundry Pads and Covers • Bowling Balls

NEW PRODUCTS

ply line. The units do not interfere with operational air pressures—they can all be operated at different pressures if desired. Design uses only one moving part.

Wilkerson Corp.
Englewood, Col.
CIRCLE 310 ON PAGE 97

HYDRAULIC FILTER

. . . tells when to clean

Designation: Tell-Tale

Features: Full-flow cartridge type filter has a glass port for visually checking oil condition, a mechanical indicator to tell when to clean, or a limit switch to operate remote signals. A built-in by-pass action prevents damage to equipment if

cleaning signals are ignored. Cartridge is easily accessible for cleaning. Available for suction or return line use, high pressure models for pressure line use. 5, 20, 50, and 100 gpm sizes in both types.

Rosaen Co.
Hazel Park, Mich.
CIRCLE 311 ON PAGE 97

SOLENOID VALVE

. . . controls corrosive media

Designation: Series 2000

Features: Unit is designed to control high pressure corrosive gases

and fluids or elusive gases such as hydrogen and nitrogen. Valve is a direct lift type and is machined from 316 Stainless Steel bar-stock.

Specifications: Available in ⅛", ¼", ⅜" and ½" pipe sizes and is rated to 6000 psi. Teflon or nylon seats are optional, and an explosion-proof housing can be supplied.

Atkomatic Valve Co., Inc.
Indianapolis, Ind.

CIRCLE 312 ON PAGE 97

BRASS NEEDLE VALVES

. . . for 400 psi service

Designation: 3000 Series

Features: Units can be used as shut-off or throttling valves in controlling the flow of air, water, oil or other fluids not injurious to

brass. A taper metal to metal seal is used between bonnet and body eliminating gaskets or joint compound. Valves are for use at pressures up to 400 psi and are bubble tight on air at that pressure. Available in ⅛, ¼ or ⅜ in. sizes, male or female.

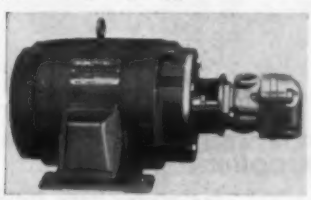
Generant Engineering Co.
Newark, New Jersey

CIRCLE 313 ON PAGE 97

PUMP MOTORS

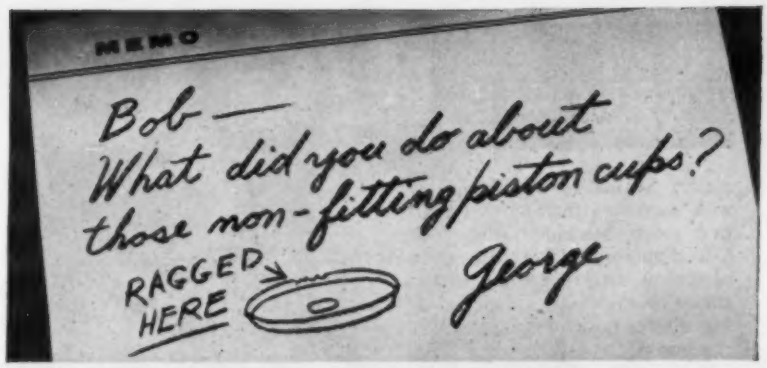
. . . offer compact pump mounting

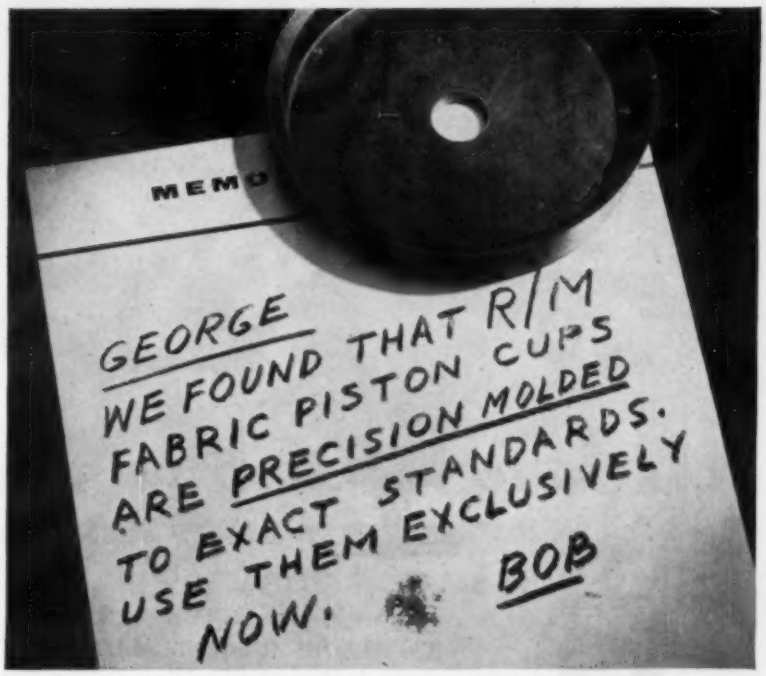
Features: Motors for close-couple hydraulic pump applications come



in sizes from one to 200 hp. Units are available in all standard enclosures—totally-protected, totally-enclosed and explosion-proof—for performance in all operating environments. The motors may be specified with single or double shaft extensions, for mounting pumps at one or both ends of the

Continued on next page





You can be sure of minimum friction, long life, when you specify R/M Fabric Piston Cups. Molded of engineered synthetics with a variety of fabric reinforcements to suit your requirements. Superior resistance to extrusion.

Careful quality control at Raybestos-Manhattan makes a big difference you can see: clearly defined contours and cleanly trimmed edges. This is proof of dimensional uniformity, strict adherence to industry standard sizes. Your gain: maximum sealing efficiency.

R/M Fabric Piston Cups are made to fit hydraulic and pneumatic cylinders ranging in diameter from ½ to 12 in. Furnished in varying degrees of hardness for pressures up to 1500 psi and in different compounds to meet your specific operating conditions.

R/M's complete line of mechanical packings includes Vee-Flex Packings, Vee-Square Packings, Homogeneous V-rings, and Fabric Piston Cups. Write for complete information.

RM PACKINGS
RAYBESTOS-MANHATTAN, INC.
PACKING DIVISION, PASSAIC, N.J.
MECHANICAL PACKINGS AND GASKET MATERIALS

RAYBESTOS-MANHATTAN, INC., Mechanical Packings • Asbestos Textiles • Industrial Rubber • Engineered Plastics Sintered Metal Products • Abrasive and Diamond Wheels • Rubber Covered Equipment • Brake Linings Brake Blocks • Clutch Facings • Industrial Adhesives • Bowling Balls • Laundry Pads and Covers

CIRCLE 80 ON PAGE 97

NEW PRODUCTS

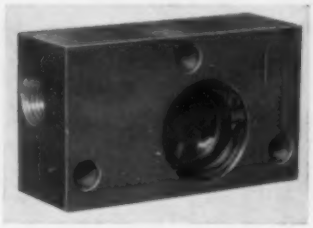
motor. Standard NEMA C-face with shortened shaft saves installation space. Machined fits on the C-face motor bracket and special mounting bracket provide concentricity of shaft and mounting face for direct, positive attachment of the pump.

Reliance Electric and Engineering Co.
Cleveland, Ohio
CIRCLE 314 ON PAGE 97

FILTER INDICATOR

. . . measures pressure drop

Designation: SpinDicator



Features: Unit is connected in parallel with any filter; a spinner mounted behind a window starts to revolve when pressure drop across the filter exceeds a particular value, indicating a clogged filter element. The unit may also be used to indicate pressure drops across other hydraulic components. **Specifications:** Setting range is from 2 psi to the 3000 psi maximum working pressure of the unit. Initial spin flow is 40 cu. in./min. Measures 3 x 1¾ x 1¼ inches. ¼ in. NPT porting.

Schroeder Bros. Corp.
McKees Rocks, Pa.
CIRCLE 315 ON PAGE 97

CONTROL VALVE

. . . for 10,000 psi

Designation: Type 505

Features: Designed for 10,000 psi service, the valve provides close control in the handling of gases and

liquids in high pressure drop, on-off or throttling service, with dead-end shutoff. Available in either direct or reverse acting models. Reverse acting has O-ring stem seal and actuating pressure connection under diaphragm.

Specifications: Unit operates at pressures to 10,000 psi and temperatures from —40 to 400 F. Weight is 63 lbs; connections are ½ or ¾ in. NPT.

A. W. Cash Co.
Decatur, Ill.
CIRCLE 316 ON PAGE 97

PORTABLE OIL RECONDITIONERS

. . . for water-base fluids

Designation: MBW-1, MBW-2, MBW-4

Features: The three models are for flow rates of 5 gpm, 10 gpm, and 20 gpm. A sintered bronze filter element is cleaned by means of a flow controlled backwash valve. The element does not affect the oil-

Continued on page 116

The ARROW AUTOPNEUMATIC CONTROL is the answer to your compressed air problems

Write for Free Catalog

ARROW TOOLS, INC.
1934 S. Kostner Ave.
Chicago 23, Illinois

***Hard-digging Wagner "Pow'r-Ho" Model 90** counts on a rugged 2000 psi hydraulic system to power the bucket, lift the boom and crowd the dipperstick . . . smoothly, efficiently—with feather-touch hydraulic control.*

How the rugged WAGNER "Pow'r-Ho" bites 12-feet deep

. . . another application for DENISON hydraulic power

***Hydraulic Punch** for the "Pow'r-Ho" is supplied by a single Denison 2000 psi TMC balanced-vane pump that actuates five hydraulic cylinders.*

Whatever the job—digging gas line . . . foundations . . . or drainage ditches—the rugged Wagner "Pow'r-Ho" Model 90 backhoe bites in hard, fast and deep with hydraulic muscle-power by Denison.

Five hydraulic cylinders—actuated by a Denison hydraulically-balanced TMC vane-type pump—power the bucket . . . lift and swing the boom . . . crowd the dipperstick. It's a fast, smooth, efficient operation—with power to spare, because a rugged, Wagner-designed 2000 psi hydraulic system and the Denison TMC vane pump make it that way.

Result: Harder digging with faster time cycles that mean *more profit* to the user.

It's the kind of job your Denison hydraulic specialist can help *you* do. Ask him more about how Denison 2000 psi pumps can improve the performance of *your* equipment. Write Denison Engineering Division, American Brake Shoe Co., 1166 Dublin Road, Columbus 16, Ohio.

DESIGNERS—ENGINEERS! Write for your copy of Bulletin 201—"How to Design More Efficient Hydraulic Power Into Mobile Machinery".

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DENISON HydrOILics

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In 1958 will you buy . . .

. . . a mink for the wife?
. . . a piano for the kids?
...a vacation in Hawaii?

If it's only money that's stopping you, find out how you can get a part of the $1200 APPLIED HYDRAULICS will award winners of the 1958 Prize Paper Contest.

To get complete information:
Circle 199 on p. 97

NEW PRODUCTS

water ratio or any special additives in the fluid. An inline visual strainer traps large solids and indicates when the fluid is clean. The

filter element is available with a 5, 10, 20, 30 or 40 micron rating. Units can be used on other types of oils, solvents and fuels.

Mayhew Products Co.
Los Angeles, Calif.

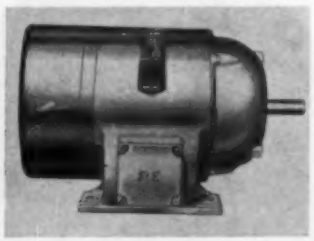
CIRCLE 317 ON PAGE 97

ELECTRIC MOTOR

. . . is combined with brake

Designation: Brakemotor

Features: Combination of designmated units gives a compact package. Wafer type brake has a dough-



nut magnet with the shaft extending clear through it, allowing mounting on the input or output sides of gears or fluid couplings.

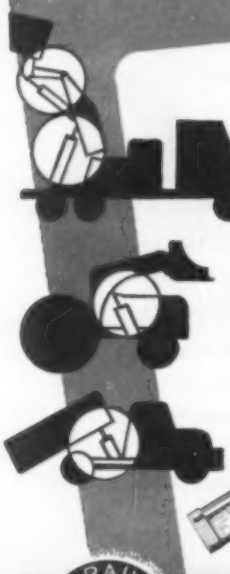
Specifications: Available in N.E.M.A. frame sizes 182 through 326U, drip proof or totally enclosed. Operating ratings of brakes are 3, 6, 10, 15, 25, and 50 foot pounds continuous duty and 3, 6, 10, 15, 25, 35, 50 and 75 foot pounds intermittent.

Reuland Electric Co.
Alhambra, California

CIRCLE 319 ON PAGE 97

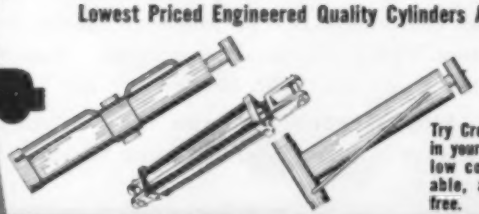
ON THE JOB...

with CROSS HYDRAULIC CYLINDERS



Like Cross customers everywhere, you can stay "on the job" with dependable, rugged Cross Hydraulic cylinders. Cross, the trade-mark of quality in hydraulic cylinders, is as near as your phone. For fast delivery on any quantity, built to your specifications, contact Cross Engineering Department.

Lowest Priced Engineered Quality Cylinders Available



Try Cross Cylinders in your operation... low cost, dependable, and trouble free.

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CIRCLE 28 ON PAGE 97

Simple, Secure . . . Leak-Tight! this FLEXIBLE SEAL SEAT*

Here's the secret . . . responsive action of the soft, long-lasting O-ring seal! Instantly compresses to seal internal and external pressures. Draws harmlessly around dirt particles. No costly precision parts or extra end seals. Six standard Dryseal pipe and JIC tube sizes: 12 connection combinations. Send for data sheet.

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7321 West 59th Street • Summit, Illinois

Kep-O-seal

HYDRAULIC & PNEUMATIC CHECK VALVES

* PATENT APPLIED FOR

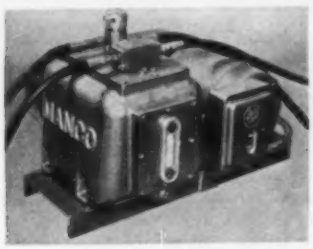
CIRCLE 57 ON PAGE 97

POWER PACKAGE

. . . provides wide delivery range

Designation: HA-1

Features: Hydraulic power and pump package for operating high pressure hydraulic equipment. Unit has an output range from 4.1 gpm at 500 psi to 3 gpm at 8800 psi. An externally located valve allows quick adjustment of pressure in the field. An internal safety relief valve is factory set at 9000 psi for tool protection; a thermal overload



device protects the pump motor. The six piston pump is powered by a 5 hp 220/440 volt, 60 cycle motor operating at 1800 rpm. Available with gas engine power.

Manco Mfg. Co.
Bradley, Ill.

CIRCLE 320 ON PAGE 97

GROOVE GAGE

. . . gives high accuracy

Features: Light weight pistol grip instrument has a measurement range of from .187 to 6.875, with repetition accuracy to .0001. Gage can be used for measuring both inside and outside dimensions. Measuring pressure is adjustable. Will

measure O-ring, Truarc ring grooves, odd grooves, bores, recesses, inside spherical radii and out-of-round conditions. Unit can be set with micrometers, gage blocks or boremaster rings.

Mueller Laboratory
Pasadena, Calif.

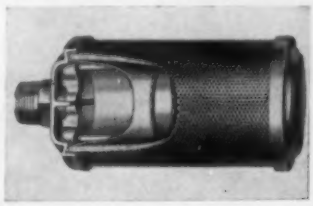
CIRCLE 321 ON PAGE 97

AIR EXHAUST MUFFLER

. . . permits high flow

Designation: Atomuffler

Features: A 4-port deflector combined with an internal acoustical



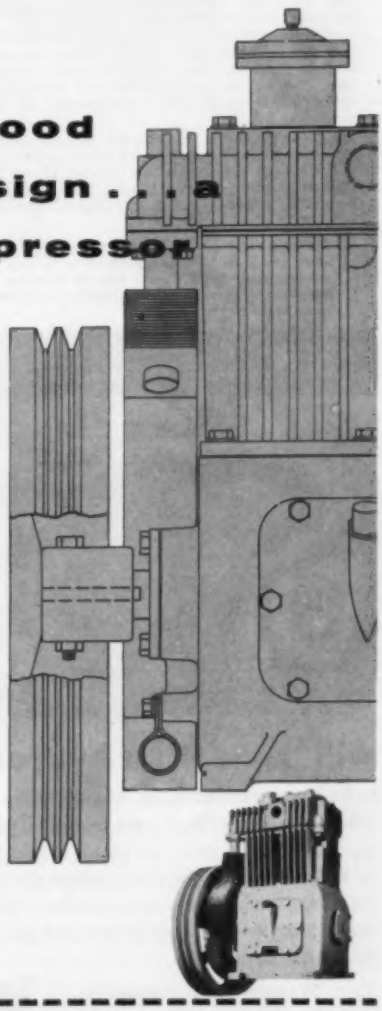
resonator gives uniform air dispersement, resulting in better noise cancellation and improved air flow. Radial dispersion reduces exhaust velocity to a minimum and eliminates oil fog and water spray. Hexhead feature permits installation with an ordinary wrench. Unit resists vibration and holds fast under severe jolting.

Specifications: Available in sizes from ⅛ to 2 in. NPT.

Allied Witan Co.
Cleveland, Ohio

CIRLCE 322 ON PAGE 97

detail of a good machine design . . . a Quincy Compressor



When compressed air is part of the product make Quincy Compressors part of the design. Not only can you be certain of buyer acceptance and first-rate performance of Quincy Compressors, but designing is made easier for you, too. That's because of Quincy's wide range of models for every need to 90 C.F.M., and expert field service available to manufacturers. Send coupon for catalog today!

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CIRCLE 78 ON PAGE 97

CIRCLE 48 ON PAGE 97

Now . . . for the first time—
A FLUID POWER TRAINING PROGRAM
to fill industry's need for trained personnel

Hitchcock's NEW "job-related" home study course
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An up-to-date practical course of study covering Theory, Fundamentals of operation, Application, Diagnosis and Repair for all types of hydraulic and pneumatic equipment and controls.

The problem of developing properly trained, qualified personnel to install, operate and maintain FLUID POWER EQUIPMENT becomes greater day by day. Design simplification and "advanced mechanization" continually expands and increases the uses of FLUID POWER to increase production and operating efficiency in all phases of industry.

Hitchcock Publishing collaborated with two of the nation's leading fluid power authorities to develop this program. Now, men can be trained "on-the-job" through home-study and daily direction in the development of practical skills in fluid power.

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USEFUL LITERATURE

FILTRATION EQUIPMENT . . . for micronic clarification of all types of fluids is described in a catalog from *Commercial Filters Corp., Melrose, Mass.* Filters are designed for high or low flow rates and pressures. Container metals and elements allow for handling solutions of varying P[H], temperature and viscosity. The catalog describes various models for full-flow and by-pass applications.

CIRCLE 410 ON PAGE 97

STEEL TUBULAR PRODUCTS . . . manufactured by *Babcock & Wilcox Co.'s Tubular Products Div., Beaver Falls, Pa.*, are covered in Bulletin TB-417. Applications, features and specifications are given for seamless and welded pressure tubing and pipe, seamless welding fittings and forged steel flanges, and mechanical tubing.

CIRCLE 411 ON PAGE 97

INDUSTRIAL O-RINGS . . . Bulletin OR-57, from *Chicago Rawhide Mfg. Co., Chicago, Ill.*, gives complete information on sizes and compounds available in a new series of standard O-rings. Units are keyed to the new uniform numbering system in accordance with SAE

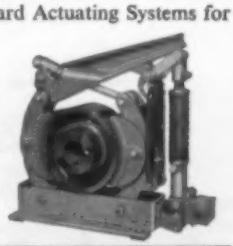
Continued on page 120

WAGNER INDUSTRIAL BRAKES

will "hold" that hydraulic winch

In fluid power applications, Wagner spring-applied hydraulic-released Industrial Brakes are finding increasing use for holding and stopping hydraulic motor drives. Special mineral oil or hydraulic brake fluid compatible parts and cast steel or malleable iron construction provide a brake to meet your needs. Wagner also supplies standard Actuating Systems for remote brake control.

Your Wagner Sales Engineer is backed by men with years of experience in braking and control system design. Let him help you solve your application problems. Write for Wagner Bulletin IU-226.



Wagner Electric Corporation
W156-2 6387 PLYMOUTH AVENUE, ST. LOUIS 14, MO., U. S. A.

STOPS PIPE THREAD LEAKS

PAT. PENDING

Satisfaction Guaranteed Or Money Back TRIAL OFFER

TRU-O-SEAL Fittings are guaranteed to seal pipe thread connections permanently against all oils, practically all known chemicals and gases; to seal under high pressures or vacuum; to withstand —280° to plus 500° F.; to eliminate "overtightening" damage and pipe dope. Available in ⅛" to 2½" pipe thread sizes.

$10.00 Trial Offer No. 1: eight ⅛", ten ¼", eight ⅜", ten ½" pipe thread TRU-O-SEAL Fittings.

$10.00 Trial Offer No. 2: eight ½", ten ¾", four 1" pipe thread TRU-O-SEAL Fittings.

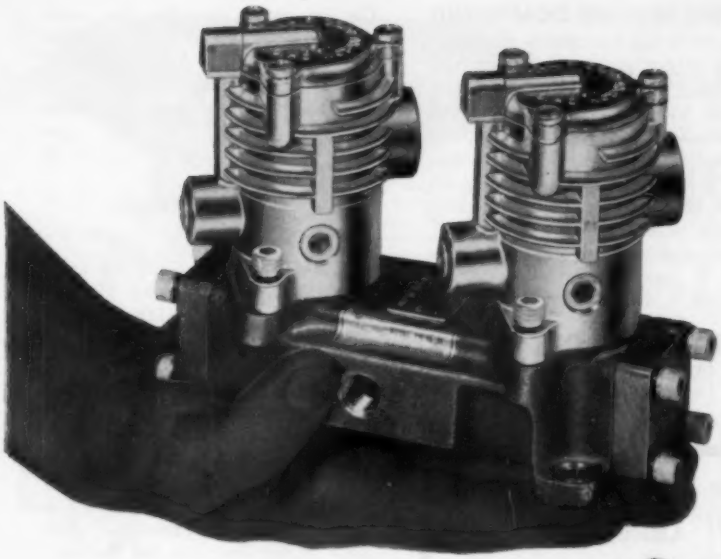
Send order to

TRU-O-SEAL DIVISION
Flick-Reedy Corp
2008 N. Hawthorne, Melrose Park, Ill.
"Miller Fluid Power" is also a Div. of Flick-Reedy Corp.

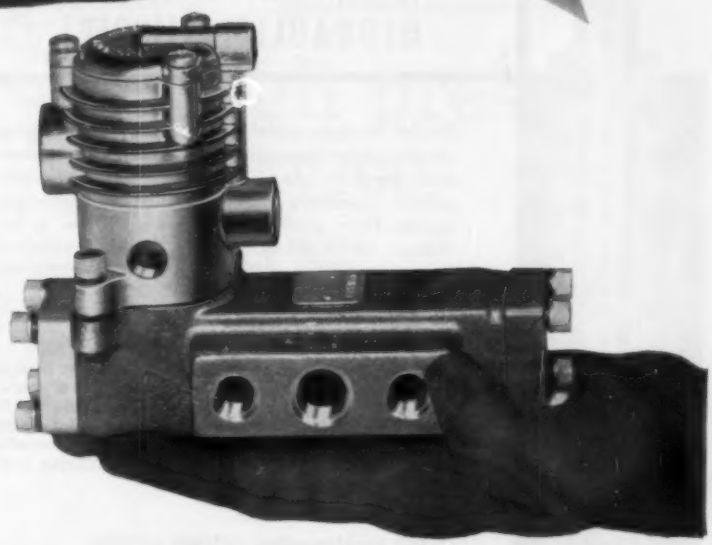
1
Thread TRU-O-SEAL on pipe or fitting (no messy pipe "dope" needed).
SEAL SIDE
2
Tighten TRU-O-SEAL to complete leakproof assembly (only light torque required).
3
Thread pipe or fitting 4 threads into port. Point in desired direction.

CIRCLE 114 ON PAGE 97

CIRCLE 101 ON PAGE 97



MODEL PD-120
$55.00
LIST PRICE
BASIC VALVE



MODEL F-120
$37.00
LIST PRICE
BASIC VALVE

op + lic = IPd + HPr

Outstanding performance plus low initial cost equals Increased Production plus Higher Profits! Apply this formula to your operations . . . use Valvair ¼ in. 4-way foot-mounted Speed King control valves. Whether you build or operate production machinery, you'll find that Speed King's compact size simplifies installation . . . instant-action response, 600 cpm speed and bubble-tight sealing assure accurate control . . . more productivity.

What's more, 20 million cycle-plus dependability and solenoid coils guaranteed against burn-out for the life of the valve keep maintenance and down-time at a minimum! Ask your Valvair representative to show you how ¼ in. Speed Kings can keep your costs down . . . your profits up! Valvair Corporation, 454 Morgan Avenue, Akron 11, Ohio. AA-6883

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CIRCLE 109 ON PAGE 97

USEFUL LITERATURE

Aeronautical Recommended Practice 568. The bulletin lists hardness ratings, compatibility and temperature ranges of O-ring compounds, has cross-sectioned drawings of typical applications and a section on the design and adaption of standard O-rings for non-standard internal and external applications.

CIRCLE 414 ON PAGE 97

LIQUID SEALING COMPOUND . . . for joints and seams on equipment where gases, oil, steam, etc. are used is described in a folder issued by *Michigan Chrome and Chemical Co., Detroit.* Compound is easily applied with a small brush, sets quickly, is insoluble in gasoline, oil, and most gases and commercial solvents.

CIRCLE 415 ON PAGE 97

ROTATING UNION . . . for air and hydraulic use is manufactured by *Deublin Co., Glenview, Ill.* Catalog sheet describes the unit, designed for speeds up to 2500 rpm, at pressures up to 150 psi air, or 2000 psi oil. Called "Model 1300", union is available with rotors having ⅜" or ½" right hand pipe threads, or ⅜" 18 N. F. threads.

CIRCLE 416 ON PAGE 97

THERMOSTATS . . . are compact, fast-reacting and have a narrow temperature differential. "Thermoswitch" units use their cylindrical metal housing as the activating control element. Expansion or contraction of the housing makes or breaks the totally-enclosed electrical contacts. Five basic types are available for various installations; all fit a ⅜ in. reamed hole. A 4-page folder from *Fenwal Inc., Ashland, Mass.*, describes the devices.

CIRCLE 417 ON PAGE 97

FLOW CONTROL VALVE . . . which maintains a constant rate of flow of up to 45 gpm depending on hand wheel setting is illustrated and explained in a bulletin issued by *Kobe Inc., Huntington Park, Calif.* The valve is O-ring sealed and has stellite inlet valve facing and seat. Exceptionally long service life is claimed for the units, which have a maximum working pressure of 5000 psi.

CIRCLE 418 ON PAGE 97

RING PACKINGS . . . of two types, for flange widths of ¼-½ in., and over ½ in., feature compactness and high sealing efficiency. Used in multiples, "Uneepac" rings provide accurate vertical alignment and nesting. Manufactured by *Johns-Manville, New York,* the packings are described in a bulletin. Available in various compositions and styles for service in water, steam, oil, air, gas and vacuum.

CIRCLE 419 ON PAGE 97

COMPRESSED AIR DRYERS . . . A 12 page booklet from *Van Products Co., Erie, Pa.*, describes new models of heatless, self-activating, zero-dewpoint dryers. Units are designed to prevent moisture fouling of instruments, control, testers, circuits, chemicals, gases, finishes, compounds and solutions. Capacities are 1 to 5400 scfm at 100 to 3000 psi. Booklet contains dewpoint and capacity and sizing graphs, and dimensional data.

CIRCLE 420 ON PAGE 97

Good Design Deserves . . .

BHEW Custom-Built HYDRAULIC CYLINDERS

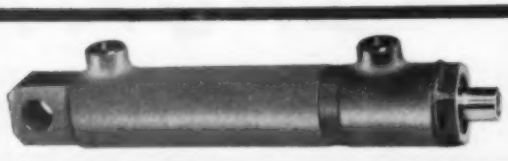
BHEW custom-built hydraulic cylinders give dependable operational performance wherever they are used. These efficient, close-tolerance cylinders require minimum mounting space; their cost is reasonable; there is no charge for tooling. BHEW builds cylinders to meet your specifications, delivers them on schedule.

BHEW CYLINDER FEATURES:

Standard and special designs available. • Double or single acting and telescopic. • 1½" to 8" bore. • Strokes up to 156". • Smallest possible O. D. and retracted O. A. length. • Oil cylinders with 1,500 psi or 3,000 psi working pressure, pneumatic up to 150 psi. • Cup-type, ring-type or O-ring construction. • Choice of mounting.

1. **Honed steel cylinder.**
2. **Full double-sealing "U" cup packing.**

Furnished in a wide variety of mountings and anchor brackets.



WRITE for your copy of Hydraulic Cylinder Engineering Reference Data Manual. Can save you hours of time in specifying cylinders. 40 dimensioned basic designs for general and special purpose double acting cylinders.

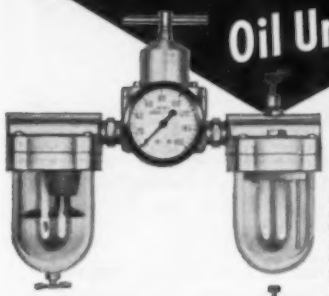
BHEW BENTON HARBOR ENGINEERING WORKS, INC.

422 LANGLEY AVENUE • ST. JOSEPH, MICHIGAN

CIRCLE 15 ON PAGE 97

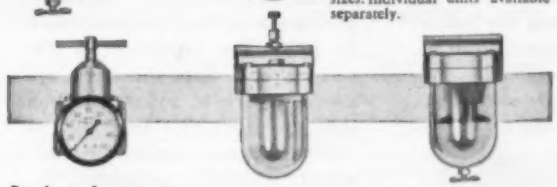
CIRCLE 4 ON PAGE 97

AIR-MITE
FILTER—REGULATOR
Oil Unit



- Instantaneous response to demand
- Special Filter for cleaner air
- Accurate injection of pre-atomized oil

The new AIR-MITE unit is designed and built for maximum operating efficiency, easy maintenance and long life Operates at pressures to 160 psi. Available in ¼", ⅜" and ½" T.P. sizes. Individual units available separately.



Regulator—Incorporates piston cup instead of diaphragm. Provides more accurate, stable regulation, lasts longer. Direct reading gauge for close regulation of outlet pressure.

Lubricator – Automatically pre-atomizes and feeds oil mist into air stream. Simple micro adjustment permits accurate balance of oil-to-air supply.

Filter – Porous sintered bronze element filters better . . . won't collapse . . . is easy to clean. Built in air baffle. Brass drain cock.

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AIR-MITE Devices, Inc.

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Water Hydraulic Systems Work Better . . .

with Houghton HYDROLUBRIC

A special soluble lubricant for closed hydraulic systems using water as the pressure medium. Mixed 1 part to 1000 parts of water, Hydrolubric will—

- Lubricate entire system
- Prevent rust
- Prevent pitting
- Reduce wear
- Increase packing life
- Assure more efficient operation of pumps and valves
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Ready to give you on-the-job service . . .

DESIGN ENGINEERS...

need a small valve on

- GAS AND LIQUID ANALYSIS EQUIPMENT
- INSTRUMENT AIR LINES
- LABORATORY TEST EQUIPMENT
- PILOT PLANT INSTALLATIONS
- GRAPHIC PANEL BOARDS
- HYDRAULIC AND PNEUMATIC EQUIPMENT
- AIRCRAFT AND AUTOMOTIVE TEST STANDS

for high pressure service

270 SERIES
BAR STOCK
NEEDLE VALVES

...5000 psi service. Made of brass, carbon steel, type 430F or 316 SS, or a combination carbon and 430F SS for high temperature service. Designed for throttling and shut-off of water, oil, gas or corrosive fluids. Features leak-tight O-ring stem seal. Can be panel mounted, too. Sizes ⅛" through ½".

or reverse flow check

570 SERIES
CHECK VALVES

Feature extremely effective leak-tight seal, exceptional flow characteristics and low-cost. Synthetic rubber seats and stainless steel springs give maximum corrosion resistance. Available in brass or 303 SS in ball and piston types for 5000 psi service in sizes ⅛" through ½".

Why buy big when you can buy small

WRITE FOR CATALOG MV-957

HOKE

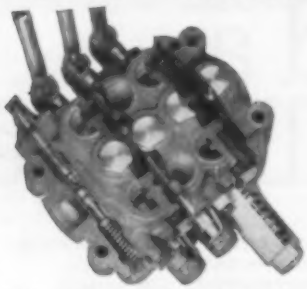
HOKE INCORPORATED
FLUID CONTROL SPECIALISTS
187 South Dean Street
Englewood, New Jersey

CIRCLE 125 ON PAGE 97

CIRCLE 49 ON PAGE 97

CIRCLE 53 ON PAGE 97

NEW HUSCO "3200" VALVE



- Choice of ONE to SIX plungers, with sealed ends—in completely balanced design.
- FOUR Control Positions—raise, lower, float, neutral—with or without detent.
- Pilot-Operated Relief permits setting to maximum of 50 *lb. variation*—for H.P. savings.
- Accurately rated capacity—35 G.P.M.—with high pressure carryover.

Check HUSCO first for modern hydraulic units engineered to your specific needs—cylinders, control valves, rotary swivels, selector valves, and others. Write or phone—

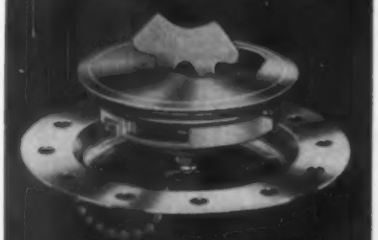
HUSCO **HYDRAULIC UNIT SPECIALTIES CO.**

Pumps • Valves • Cylinders

P. O. Box 257-A, Waukesha, Wis.

GABB

FC-3500



TANK FILLER CAP

The Model FC-3500 is the first tank filler cap to successfully pass all test requirements of MIL-C-7244B (ASG) applicable to fuel, oil, alcohol-water and hydraulic reservoirs.

Lever action design permits cap to be opened safely under pressure and removed completely with only a 35° turn. Now available in 1.5, 2, 3, and 3.82" openings.

Write for free literature.

GABB SPECIAL PRODUCTS Inc.

WINDSOR LOCKS, CONN.

CIRCLE 36 ON PAGE 97

POST SCRIPTS OF INDUSTRY

News about people, manufacturers and sales organizations

Tomkins-Johnson, Jackson, Mich., has announced the following personnel changes: **John E. Rowe,** formerly with Ross Operating Valve Co., Detroit, Mich., has been named to the newly created post of executive vice president. **William J. Remund** has been promoted from sales manager to the new post of vice president in charge of sales. **Adam P. Jankowski** is now sales manager of the company.

John E. Rowe
Tomkins-Johnson

William J. Remund
Tomkins-Johnson

Superior Tube Co., Norristown, Pa., is constructing a new office building and mill addition at its general offices and main plant. The $2 million construction is part of a $5 million expansion program scheduled for completion in 1958. The expansion of Superior's main plant and office will provide space to consolidate and simplify production lines and to house increased engineering, laboratory and office personnel.

Parker-Hannifin Corporation, Cleveland, Ohio, has appointed **Palmer Supply Co.,** 222 Westlake North, Seattle 9, Wash., distributor for Parker hydraulic hose and Hoze-lok fittings and Parker tube fittings in the Northwest and Alaska.

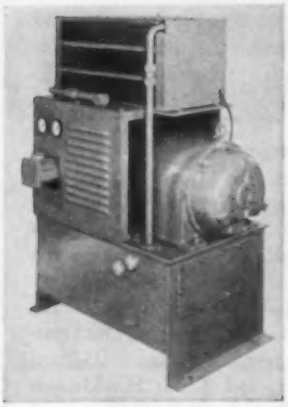
Don Benkert has been appointed manager, engineering and sales, of the newly-formed Still-Seal Gasket Department at **Stillman Rubber Co.,** Culver City, Calif. Benkert previously headed the group responsible for operation and performance of the fluid systems of missiles and drones at Radioplane Co., Van Nuys, Calif.

Allis-Chalmers Mfg. Co., Milwaukee, Wisconsin, has announced two appointments at its Norwood, Ohio, Works: **Charles McCullough** has been named to a post in the manufacturing department, and **Richard P. Quintin** as an assistant in methods engineering.

William P. Spencer has been advanced to the position of field engineer, Detroit district, by the **National Oil Seal Division** of **Federal-Mogul-Bower Bearings, Inc.,** Redwood City, Calif. Spencer will specialize on National Oil Seal automotive customers in the Detroit area.

Continued on page 124

CIRCLE 84 ON PAGE 97



NEW
AIR-TYPE HYDRAULIC OIL COOLER

Reduces component costs and eliminates need of water piping

Make even your hard-working circuits work harder by removing excessive heat with a Rosaen oil-air cooler. There's no need for water in this air-cooled system, so you eliminate both the installation cost, and the waste, of water. The oil-air cooler takes no floor space, mounts directly over the power unit, as shown. In planning new circuits, those expensive components dictated by the need to keep the oil cool may be left out, and this cooler included at less over-all cost to efficiently cool the oil.

Both 12 gpm and 25 gpm models are available, are guaranteed for use with 30 psi fluid at 250° F. Also new is the Rosaen air-cooled reservoir, a cooler and reservoir combination that serves as a base for small power units. Write for complete catalog information.

The ROSAEN COMPANY
1776 EAST NINE MILE ROAD • HAZEL PARK, MICHIGAN

CIRCLE 87 ON PAGE 97

NEW, Small, Sturdy . . . ideal for AUTOMATION!

The modern economical answer to trouble-free handling of *little* shop and production line jobs

- Goes where hands can't—replaces die springs, actuates jigs and fixtures.
- Universal or pivot mounting surfaces are square!
- Spring return or double acting. 1", 2" and 3" strokes in stock, others on order.
- Synthetic rubber packing is long-wearing, self-adjusting.
- Rods are high tensile steel, hard chrome plated.
- Compact, dependable construction of brass, steel, and aluminum alloy.
- 1 1/8" Bore—150 psi air; 400 psi hydraulic.

SHEFFER

Write, NOW, for Bulletin 656

THE SHEFFER CORPORATION
Cincinnati 15, Ohio

Manufacturers of the industry's most complete line of air and hydraulic cylinders

SOLD BY LEADING DISTRIBUTORS NATIONWIDE

The international pipe couplings of proved efficiency

EQUAL ELBOWS *to suit N.B. pipe sizes* ¼" *to* 1¼"

EQUAL CROSSES *to suit O.D. pipe sizes* ⅜" *to* 1½" *and N.B. pipe sizes* ¼" *to* 1¼"

BANJO COUPLINGS TYPE 1 *to suit O.D. pipe sizes* ⅜" *to* ⅞" *and N.B. pipe sizes* ¼" *to* ½"

STRAIGHT COUPLINGS *to suit N.B. pipe sizes* ¼" *to* 1¼"

ERMETO high pressure couplings have several outstanding qualities, not the least of which is their trouble-free service even in conditions of extreme vibration. Beyond the removal of burrs no work is necessary on the pipe ends. Joints are made in a matter of moments and when required can be broken and re-made any number of times without impairing the pressure tightness. Because of our specialized knowledge we have created a range of fittings to suit almost every conceivable purpose, but we are always prepared to supply fittings to suit individual requirements.

ERMETO

Literature and catalogues gladly sent on request

BRITISH ERMETO CORPORATION LTD
Hargrave Road Maidenhead Berks

Phone: Maidenhead 2271/4 Grams: Grambon, Maidenhead

CIRCLE 17 ON PAGE 97

POST SCRIPTS OF INDUSTRY

Cuno Engineering Corp., Meriden, Conn., has announced the election of **George K. Fraser,** Rear Admiral U.S.N. (ret.), as vice president in charge of engineering, research and development.

Hercules Packing Corp., Buffalo, New York has purchased the **Johnson Machine Co.** of Conneaut, Ohio. Johnson Machine will continue the manufacturing of rubber molds under the new management.

B. L. Moss, president of **Hydromatics, Inc.,** has announced transfer of operations to a new plant at 70 Okner Parkway, Livingston, New Jersey. The new plant of 15,000 sq. ft., will house engineering, production and administrative activities.

A new corporation, **Roper Hydraulics, Inc.,** Rockford, Ill., has taken over the pump business of **Geo. D. Roper Corp., Pump Division.** This has separated the pump operations from the household appliance activities of the corporation. **John H. Makemson** is president of Roper Hydraulics, Inc., and **J. M. Hoskinson** is sales manager.

J. M. Hoskinson
Roper Hydraulics, Inc.

J. H. Makemson
Roper Hydraulics, Inc.

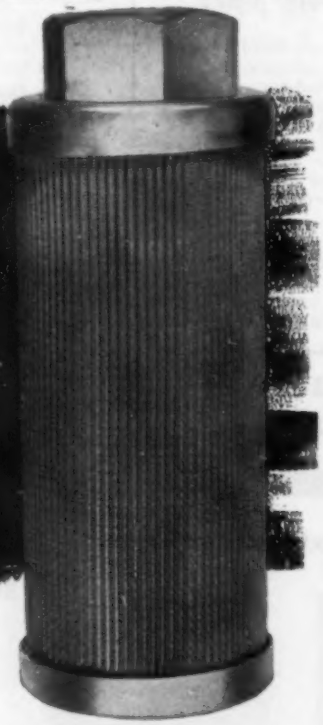
Change in address of two district sales offices of **The Babcock & Wilcox Company's Tubular Products Division** was announced by James S. Anderson, vice president. In Syracuse, N. Y., the division's office has been moved to the Romax Bldg., 731 James St., Syracuse 3, N. Y. It was formerly at 250 Harrison St. The Boston, Mass. office has been relocated at 66 Central St., Wellesley 81, Mass. from its former address at 250 Boylston St., Boston.

Continued on page 126

Capital

HYDRAULIC OIL FILTER with Monel Metal Insert

Reservoir Type for Hydraulic and Oil Re-circulating Machinery



EASY TO INSTALL—EASY TO CLEAN
LONG LIFE—LOW COST—SIZES AND SCREENS TO FIT YOUR NEEDS

★ ONLY THREE PARTS
★ MEETS J.I.C. STANDARDS
★ GREATER FILTERING AREA
★ SPECIAL TRAP-WEAVE MESH

Specially woven MONEL wire cloth and a new method of compact corrugation, gives triple protection with less space than other filters of like capacity. Trap-weave mesh stops thin, elongated particles with NO loss of efficiency.

Non-corrosive, non-toxic materials throughout. Easily cleaned with an ordinary brush.

Write for descriptive circular.

CAPITAL ENGINEERING & MFG. CORP.

5836 SOUTH ASHLAND AVENUE, CHICAGO 36, ILLINOIS

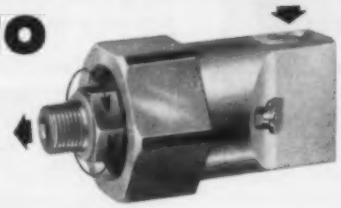
CIRCLE 18 ON PAGE 97

CIRCLE 12 ON PAGE 97

For High Speed Rotating Connections on
SPINDLES • CHUCKS • CLUTCHES

BARCO

NEW
TYPE D
REVOLVING
JOINT



UP TO 10,000 RPM!

Use Barco's new TYPE D Revolving Joints wherever you need high speed, low torque, leakproof rotary connections for air, hydraulic, or coolant lines on clutches, machine tools and other equipment:

- **LIGHT RUNNING!** Ball bearing design for low torque and minimum wear.
- **LEAKPROOF!** Thanks to Barco's static O-ring seal.
- **PRECISION-BUILT!** All parts machined to close tolerances. Parts interchangeable and easily renewable.
- **COMPACT, DURABLE!** Easy to install where space is limited. Overall length, 3 1⅛". Built for rugged service.
- **WIDE SPEED RANGE!** Up to 10,000 RPM. For pressures to 300 psi (air) or 3000 psi (hydraulic).

Send for Catalog Sheet 308.

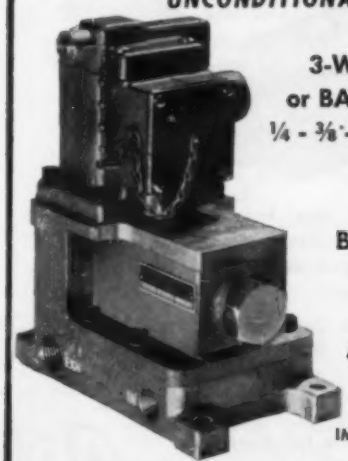
BARCO MANUFACTURING COMPANY
532C Hough Street • Barrington, Illinois

CIRCLE 63 ON PAGE 97

When the design calls for
an indicating gauge, specify
the best—
MARSH
New catalog covers gauges for every need
MARSH INSTRUMENT CO.
Sales Affiliate of Jas. P. Marsh Corporation
Dept. 19, Skokie, Ill.
Marsh Instrument & Valve Co. (Canada) Ltd
8407 103rd Street, Edmonton, Alberta
Export Dept.,
3501 Howard Street, Skokie, Ill.

Solenoid Operated AIR VALVES
conform to all J.I.C. Standards

Stop Your Solenoid Troubles with AV VALVES
Designed & Engineered for Many, Many Millions of Trouble Free Operations & Backed by 1 Year UNCONDITIONAL GUARANTEE



3-WAY IN-LINE
or BASE MOUNTED
¼ - ⅜ - ½ - ¾ - 1 - 1¼

• • • •

4-WAY
BASE MOUNTED
¼ - ⅜ - ½ - ¾

COMPLETE LINE OF AIR CONTROL VALVES

STOCKING REPRESENTATIVES IN IMPORTANT INDUSTRIAL CENTERS

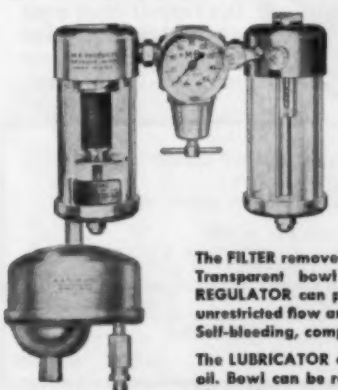
Write for Bulletin and New Low Prices

AUTOMATIC VALVE CO.
37419 GRAND RIVER AVE., FARMINGTON, MICH.

GREATER PROTECTION to your AIR LINE!

M·B

WHIRL-A-WAY FILTER, REGULATOR AND LUBRICATOR ASSEMBLY AND AUTOMATIC AIR TRAP (MODEL W-4)



SUCCESSFULLY USED FOR PROTECTION OF AIR VALVES CYLINDERS CONTROLS PNEUMATIC TOOLS, ETC.

The FILTER removes solids .00039 and larger. Transparent bowl provides visibility. The REGULATOR can pass large volume with an unrestricted flow and minimum pressure drop. Self-bleeding, compact.

The LUBRICATOR delivers desired volume of oil. Bowl can be refilled without shutting off air supply.

The Air Trap is automatic and eliminates manual draining.

M·B PRODUCTS
46 VICTOR AVE., Div. 10
DETROIT 3, MICHIGAN

CIRCLE 10 ON PAGE 97

CIRCLE 64 ON PAGE 97

COMPLETE GUIDE
to Air and Oil Circuit Design
1958/59 FLUID POWER DIRECTORY

800 PAGES—5 SECTIONS . . . Components Directory section lists more than 650 companies who manufacture 140 products from accumulators to wiper rings.

More than 150 manufacturers put specification type advertising in the Catalog section.

Fluid Power Design—a 224 page section includes JIC and ASA standards, nomographs, charts, product information, over 150 circuits, applications and developments.

A Trade Name section and "Where to Buy Locally" section complete this "bible" of fluid power application and engineering.

$6.50 per copy

Order your copy from:

APPLIED HYDRAULICS
812 Huron Road
Cleveland 15, Ohio

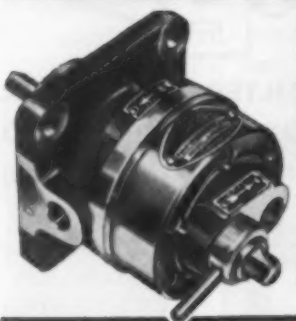
POST SCRIPTS OF INDUSTRY

Formation of a new company to conduct research and development work for government and industry and to produce a line of electronic, mechanical and electro-hydraulic products was announced by **Donald G. O'Brien,** President and Chairman of the Board. **American Measurement & Control, Inc.,** Waltham, Mass. will concentrate its activities in the general field of instrumentation and control.

Appointment of **Great Lakes Rubber & Supply, Inc.,** 3118 North Teutonia Ave., Milwaukee 6, Wisconsin, as distributor of Parker synthetic rubber O-rings has been announced by D. A. Cameron, general sales manager

Sterling, Inc., manufacturers of temperature control equipment, has announced completion of a new $200,000 plant and office building at 5200 West Clinton Ave., Milwaukee 18, Wisconsin. The one story brick and concrete block structure has 21,000 square feet of floor space and is expected to meet needs.

SAVERY ANNULAR PISTON PUMP



Infinitely variable from maximum output down to zero. Working pressures up to 1500 p.s.i. Fixed delivery models also available.

This compact rotary pump without Gears, Valves, Vanes or Springs is of unique design and simple in construction.

The pump has the following desirable characteristics:

- Volumetric efficiency as high as 99%
- Absolute positive action and steady uniform flow at slow speeds
- No aeration or turbulence of the fluid
- The path of the fluid through the pump is unidirectional and the internals are constantly swept by the fluid
- No idle pockets or passages to cause air locks or allow coagulation
- Completely self-lubricating, ensuring capacity to run for long periods without attention
- Leakproof

U. S. and CANADIAN AGENT
DAVIES BROS., GLADSTONE, NEW JERSEY

Thomas Savery Pumps Ltd., Birmingham, England

DOUBLE SELECTOR VALVE

GRESEN HYDRAULICS

A NEW GRESEN PRODUCT NOW AVAILABLE

Model DS-75

FEATURES: Cast iron body—pressure balanced spool—Easy to mount—Chrome plated spool—Optional three handle positions.

SPECIFICATIONS: Capacity—24GPM @15 ft/sec.
Pressure range —0 to 1500 PSI
All openings—¾" NPT
Shipping weight—12 lbs.

Write for literature

GRESEN MANUFACTURING CO.

405-35 Ave. N. E. Dept. AH-28 Minneapolis 18, Minn.

CIRCLE 85 ON PAGE 97

CIRCLE 43 ON PAGE 97

of **Parker-Hannifin Corp.**, Cleveland, Ohio.

Malcom S. Clark, president of **Snap-Tite, Inc.**, Union City, Pa., has announced these executive promotions: **Leonard M. Clark** moves up from sales manager to

Leonard M. Clark
Snap-Tite, Inc.

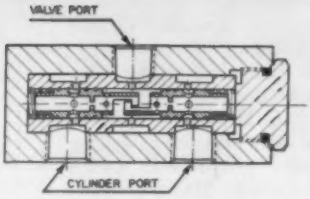
vice president; **George F. Haggar**, formerly director of engineering, is now vice president of engineering. Haggar was associated with the aircraft industry before joining Snap-Tite. **George A. Clark** has been made treasurer of the coupling manufacturing firm.

CIRCLE 33 ON PAGE 97

NEW Low Cost
Flow Divider

. . . divides the flow from one pump into two equal parts.

. . . combines two flows into one.



- Input Ranges — 1 gal to 4 gpm
  — 3 gal to 10 gpm
- Pipe size — ⅜"
- For oil
- 2000 psi

Write for detailed specifications and prices.

Fluid Controls, inc.

Manufacturers of Hydraulic Valves and Devices

Relief Valves • Check Valves • Restrictor Valves
Needle Valves • Pilot Check Valves • Special Valves
Pressure Compensated Flow Regulators

1284 N. CENTER STREET • MENTOR, OHIO

Member NFPA

"Wipe out" PACKING FAILURES WITH Seal-Guard METALLIC ROD WIPERS

Self-adjusting, easy to install, Seal-Guard's knife-like bronze rings "wipe off" all dirt and grime, will not mar the rod, are oil and heat resistant and friction-free.

HOW SEAL-GUARD WORKS

1. **Twin wiper rings are mounted on rod with notches staggered.**
2. **Cushion ring is compressed on assembly exerting constant inward pressure keeping ring in constant contact with rod.**
3. **Harmful substances are completely cleared by scraper action.**

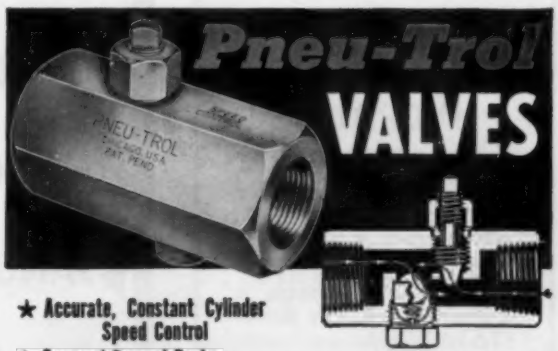
Seal-Guards are available to fit rod diameters from ¼ to 24 inches. Other sizes by special order.

WRITE FOR DESCRIPTIVE LITERATURE.

HYDRAULIC ACCESSORIES CO.
24301 Hoover Rd. Van Dyke, Mich.

CIRCLE 51 ON PAGE 97

Pneu-Trol VALVES



★ **Accurate, Constant Cylinder Speed Control**
★ **Compact Rugged Design**
★ **Simple, Easy Speed Selection** ★ **For Air, Oil or Water Applications**

Pneu-Trol Speed Control Valves, are widely used in hundreds of control applications because they combine in a short, compact body, a tapered fine thread needle for extremely accurate air or oil flow control and a floating retro ball check, which permits full flow in the opposite direction. Retro ball floats in most sensitive position to its seat, requiring only a slight differential pressure to fully open or close it.

Needle design permits maximum flow capacity in the controlled direction. Metal to metal needle and ball seats insure long trouble-free service. Simple, practical "O" gland structure eliminates troublesome leaking. Valve bodies machined from hex brass or aluminum for 2000 psi working pressures; steel and stainless steel for 5000 psi. Made in 5 female pipe sizes—⅛" to ¾". ATTRACTIVE PRICES . . . IMMEDIATE DELIVERY.

Write for illustrated circular and prices.

Pneu-Trol DEVICES, INC.
1426 N. KEATING AVENUE • CHICAGO 51, ILL.

CIRCLE 75 ON PAGE 97

O. E. M. SALES SUPERVISOR-Hydraulics

This man will handle a Minneapolis home office territory himself and supervise field sales engineers. Responsibilities include forecasting, budgeting, approval of advertising. Opportunity is just right for a successful sales engineer ready for more responsibility.

Products: Hydraulic power equipment and power steering systems. Requirements: Engineering degree or strong equivalent. Minimum age 29. 6 years sales experience, selling engineered products to Original Equipment Manufacturers. 3 years experience in sales or product engineering of hydraulic or pneumatic equipment.

SESSIONS ENGINEERING COMPANY
(for client)

Management Consultants

1562 Northwestern Bank Bldg.
Minneapolis, Minnesota

MISSILES

SENIOR HYDRAULIC ENGINEER

An interesting situation with a future in Raytheon's expanding missile program.

Background: 5-10 years in design of aircraft or missile hydraulic components, specifically . . . electro-hydraulic servo-valves, system servo analysis, optimization of servo-mechanism parameters. Should have EE or ME with special training in application of hydraulic servo-mechanisms.

For interview: please write to V. Crowninshield.

RAYTHEON MISSILE SYSTEMS DIVISION

Raytheon Mfg. Company
Missile Systems Division
Bedford, Massachusetts

THE MARKET PLACE

When replying to a box number in the Market Place, address your letter to Applied Hydraulics, 812 Huron Road, Cleveland 15, Ohio. Attention: Box No.

SALES MANAGER

Aggressive young company specializing in the industrial application of hydraulic accumulator and control systems has opening for a man with a mechanical engineering background to handle sales and development work. Please furnish full details of previous training, experience and a recent photograph with your letter of application. Home Office—New Orleans. Write to Box 2158 APPLIED HYDRAULICS.

ELECTRONIC SCIENTISTS, METALLURGISTS, PHYSICISTS, TECHNOLOGISTS AND ENGINEERS (AERONAUTICAL, ELECTRICAL, ELECTRONIC, INDUSTRIAL, GENERAL, MECHANICAL AND POWER PLANT)

The Naval Air Material Center, Philadelphia 12, Pa., has an urgent need for qualified engineering and scientific personnel to fill vacancies in the above positions. The Center is currently engaged in an extensive program of aeronautical research, development, experimentation and test operations for the advancement of Naval aviation. Starting salaries range from $4480 to $7570 per annum. Application for Federal Employment, Standard Form 57, should be filed with the Industrial Relations Department, Naval Air Material Center, Naval Base, Philadelphia 12, Pa. Applications may be obtained from the above address or information as to where they are available may be obtained from any first or second class post office.

PROJECT ENGINEER

Desires responsible position in sales project work. Ten years experience in hydraulic sales-service, valve-cylinder design; Project manager on missile ground support equipment—Process Industry hydraulic controls. Middle Atlantic or Southern states, or as required. $12,000 minimum. Write to Box 2258, APPLIED HYDRAULICS.

AVAILABLE

Experienced in applications and sales of fluid power equipment to user and O.E.M. accounts, pumps, valves, cylinders, prefer Ontario, Canada territory. Write to Box 2358, APPLIED HYDRAULIS.

Classified Advertising Rates:

Cost of Position Wanted Ad is $10.00 for the first inch, each additional line 90 cents. Cost of all other classified ads is $20.00 for the first inch and $15.00 for each additional inch or fraction thereof. Rates for Display Ads in this section will be sent on request.

Order Extra Copies Now!

JANUARY 1958

Designers' Guide Issue

Single Copy Price $1.00
25 to 50 copies, ea. .. .75
50 or more copies, ea. .40

98 PAGES OF SPECIFICATION CHARTS

Accumulators	Air Motors
Aftercoolers	Electric Motors
Air Compressors	Fluid Motors
Oil Coolers	Packings
Air Cylinders	Gear Pumps
Oil Cylinders	Vane Pumps
Air Filters	Piston Pumps
Oil Filters	Limit Switches
Hose Assemblies	Pressure Switches
Hose Fittings	Timers
Tube Fittings	Air Valves
Fluids	Hydraulic Valves
Pressure Gages	Directional Control
Joints	Flow Control
Lubricators	Pressure Control

- **Pressure ratings**
- **Types**
- **Capacities**
- **Speeds**
- **Mountings**
- **Sizes**

Order from:

Applied Hydraulics

812 HURON ROAD
CLEVELAND 15, OHIO

CIRCLE 34 ON PAGE 97

Foster's AUTOMATIC Quick Detachable Coupler

CUTS YOUR COUPLER COSTS ON HEAVY DUTY WORK

Smaller and Lighter Than Most Light-Duty "ball-type" Couplers

THE FOSTERMATIC "BULLDOG" GRIP
"Dogs" are contoured to grip 41% of plug locking surface.

"Dogs" instead of "balls" lock steel against steel . . . hold tighter, without leakage . . . positioned by "floating steel carrier" which absorbs vibration of pulsating air. Chrome sleeve is of stress-proof, heat treated steel to withstand roughest treatment. The Fostermatic is right for 90% of all uses.

Send for New Catalog Data Book #110—No Obligation!

FOSTER MFG. CO., INC.
2850 Gravois 13-C St. Louis 18, Mo.

FOS. 5356

CIRCLE 9 ON PAGE 97

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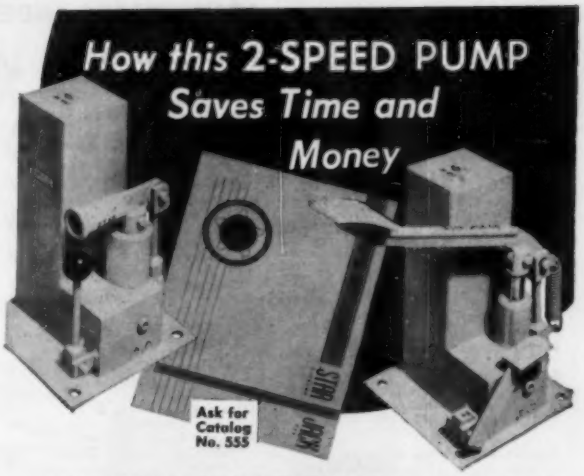

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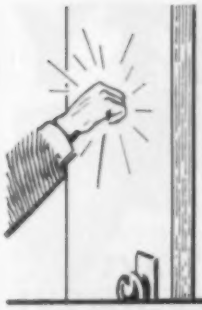

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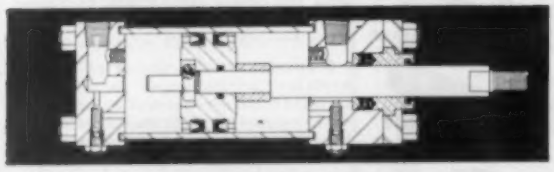

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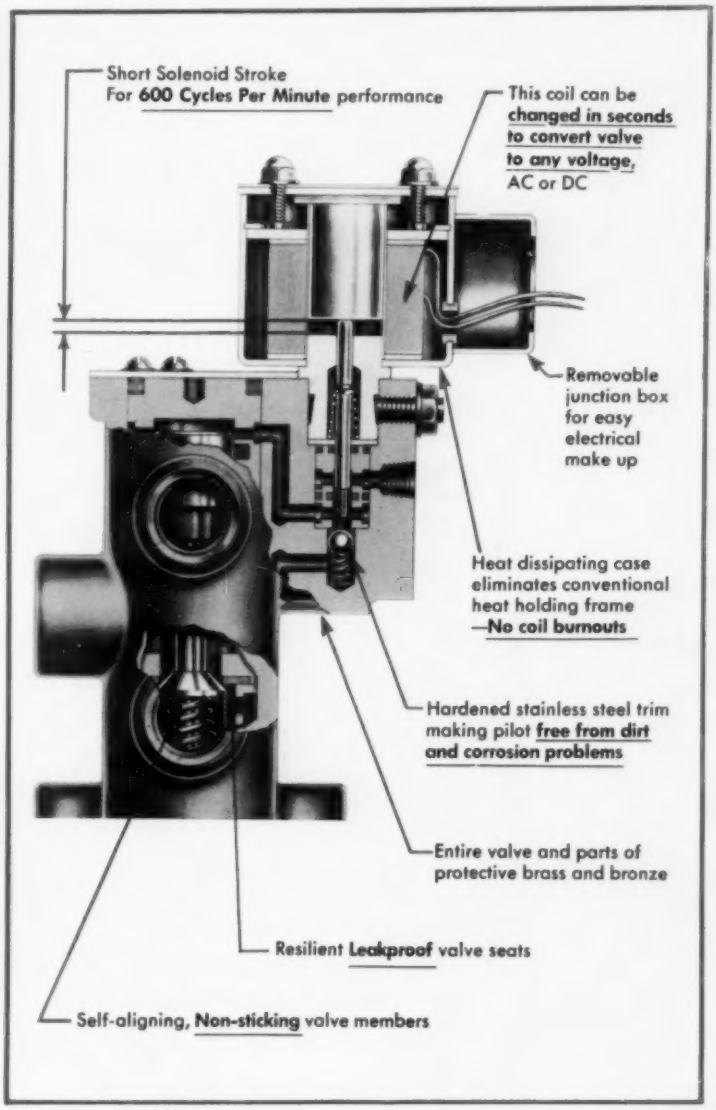
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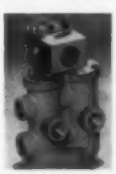
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• MARCH 5th •

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Survey
- What's Used? What's Needed?
- Selection Factors for Positive Displacement Pumps
- How to Select Air Compressors
- Boosters and Intensifiers . . . What They Are . . . How They Work

Product Design
- Accumulators as a Pressure Source
- Should Pumps Be Rated in GPM?
- Control Devices for Variable Volume Pumps
- Use a Microscope to Make a Better Pump
- Direct Mounted Pumps Simplify Assembly

System Analysis
- How to Determine Power Requirements
- Match the Pump to Frequency Response
- How to Test Low Voltage Motor-Pumps
- Pump Design Reduces System Temperature
- Hi-Horsepower Drives on Mobile Equipment

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